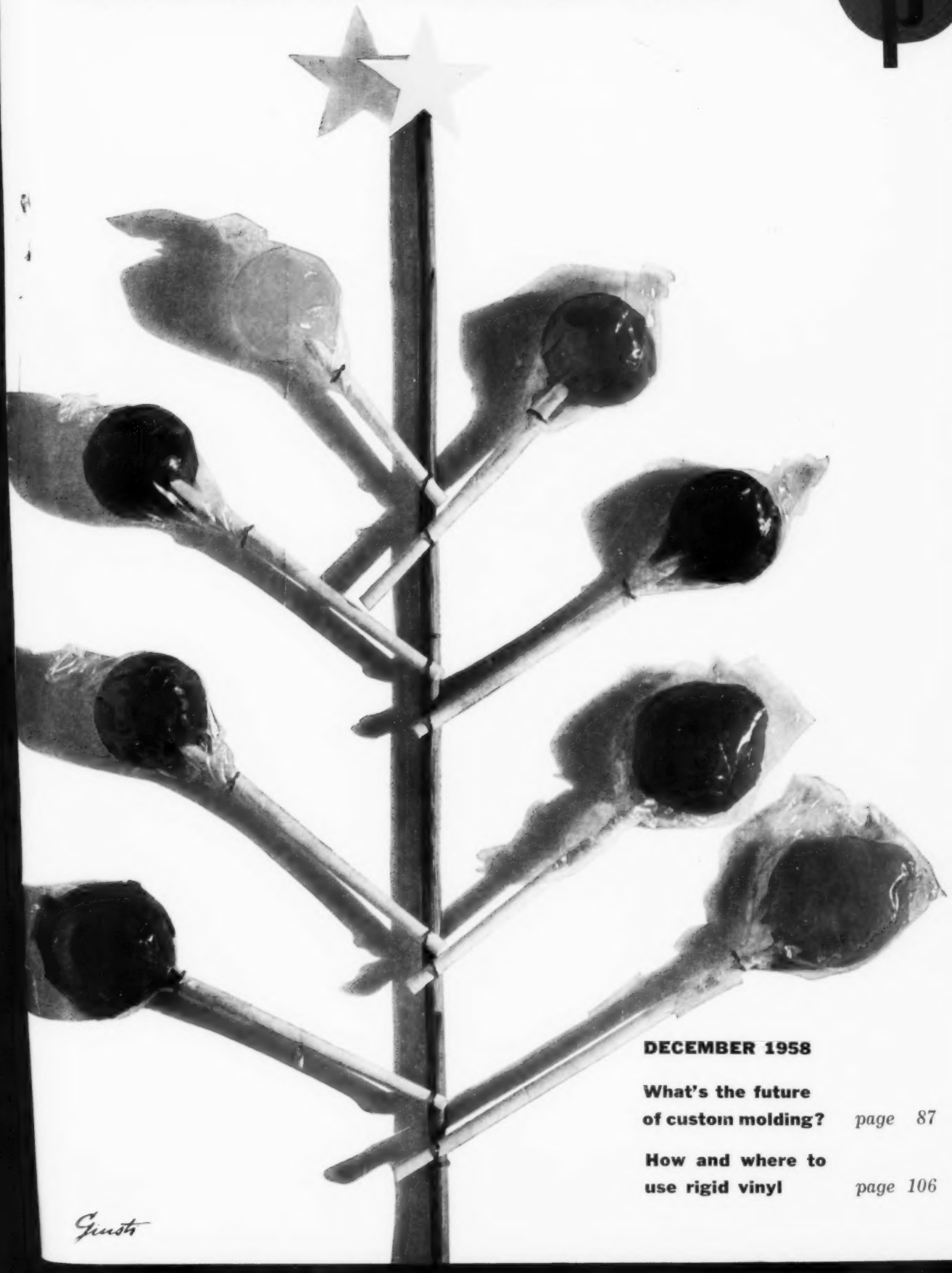
MODERN PLASTICS



Gusti

DECEMBER 1958

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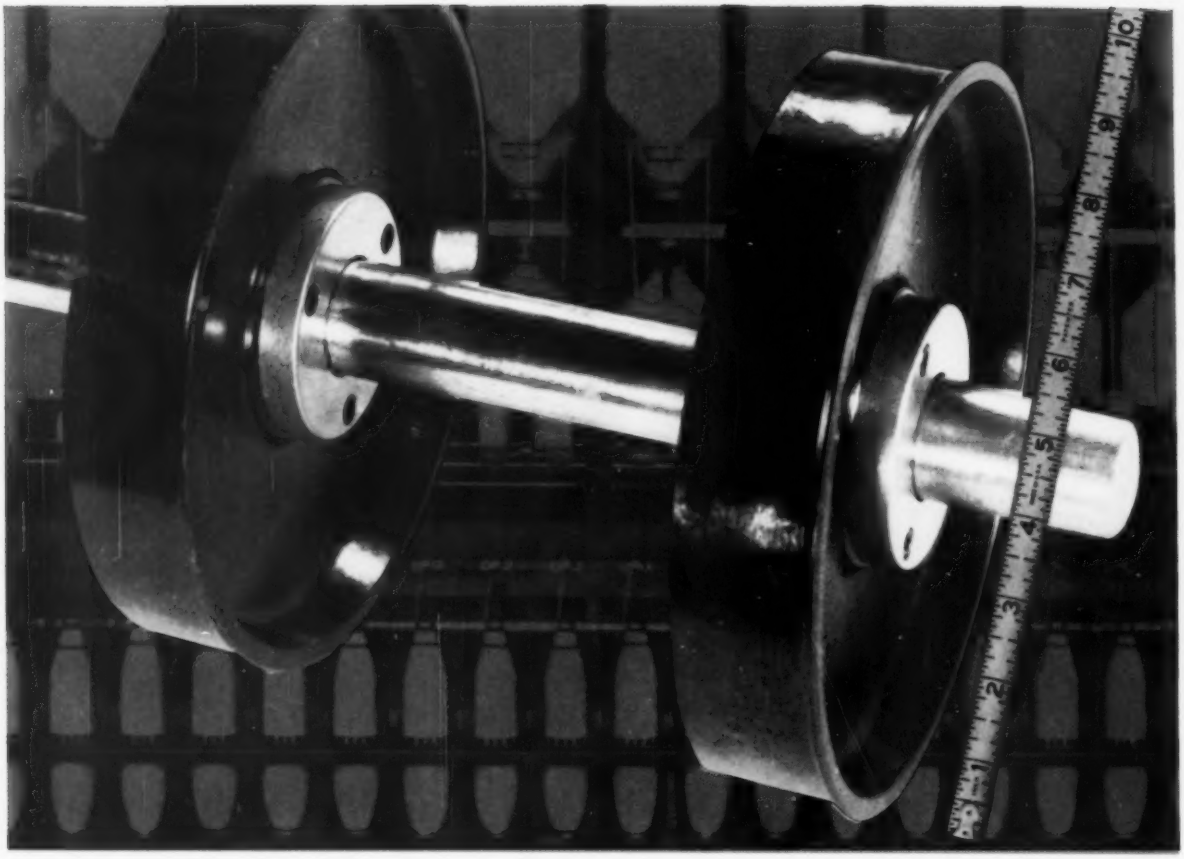
How and where to use rigid vinyl *page 106*



Now...get high-impact parts at lower cost than ever!

Have you taken a look at impact phenolics lately? Designers at Roberts Company, Sanford, N. C., did—and came up with an improved design plus significant savings.

These big pulleys drive the spindles in huge spinning frames made by Roberts Company, a leading manufacturer of textile machinery. Until recently, the pulleys were made of stamped metal or heavy cast iron.

This new phenolic does it

Designers looked for a better material. It had to be strong, dimensionally stable, yet low in cost. They found it—in Durez 18683.

This new sisal-filled phenolic solves the cost problem of high-impact parts in three ways:

1. It costs only pennies more per pound than general-purpose wood-flour-filled phenolics.
2. It molds by simple compression methods, using standard presses, standard pressures, standard dies.
3. It cures as fast as general-purpose compounds.

Despite its unprecedented low cost, Durez 18683 molds dimensionally stable parts with impact strength of 1.4 ft. lb/in. Molded parts are self-extinguishing, have excellent resistance to humidity, and can meet U/L requirements for attached electrical contacts.

Where you can save

Use Durez 18683 as your new weapon in the war against production costs. It opens the way to savings on literally hundreds of applications where higher-cost materials are used now.

Consider 18683 for heater and air-conditioner housings, instrument panels. Specify it for gears, wheels, pulleys, electric motor end bells—wherever you need impact strength and want it at lower cost.

The sooner you investigate this versatile new compound, the sooner *you'll* start saving with it! For an evaluation sample, data brochure, and prices, write us today.

DUREZ® HOOKER CHEMICALS PLASTICS

PLASTICS DIVISION
HOOKER CHEMICAL CORPORATION
1212 Walck Road, North Tonawanda, N. Y.

COSTS LESS—MOLDS FOR LESS • Sisal-filled Durez 18683 molds in standard equipment. You can preform it automatically in horizontal presses. It's available in black or natural.

Catalin POLYETHYLENE

blossoms into beauty *in flowers by* beco

The ruggedness that qualifies CATALIN POLYETHYLENE as the material for molding hard-usage items like toys and housewares is, strangely enough, the reason for its choice to capture the delicate beauty of natural blooms in Beco* flowers.

These durable, inexpensive garden-mimics — washable even in hot water — are assembled from injection-molded petals and leaves and from extruded stems, to produce lifelike roses, tulips, carnations, chrysanthemums . . . even lacy ferns! Mounted as a bouquet in a handsome flower-holder of injection-molded Catalin High Impact Styrene and attractively packaged in Polyethylene film, the blossoms are kept enticingly immaculate for display in the household they will brighten.

CATALIN POLYETHYLENE — whose versatility is thus pleasantly exemplified — is available to you for the manufacture of many other types of product — hardware, appliances, chemical and hospital ware, bottles, packages, pipe, film or sheeting —in the widest range of densities and melt indexes. From these you can select the formulation that is exactly right for your purposes. Inquiries invited.

**Beco flowers and flower-holder are manufactured by Bernard Edward Co., 5252 So. Kolmar Ave., Chicago 32, Ill.*

CATALIN CORPORATION OF AMERICA
ONE PARK AVENUE • NEW YORK 16, N. Y.

Catalin

Catalin plastics include polystyrene, polyethylene and nylon molding and extrusion compounds.

Catalin produces a wide range of urea, phenolic, cresylic, resorcinol and melamine resin formulations.

Catalin chemical intermediates and specialties include antioxidants, bacteriostats and alkalation products.

MODERN PLASTICS*

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1958
Number 4

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Modern Plastics Executive and Editorial Offices: 575 Madison Avenue, New York 22, N.Y.
Please mail all correspondence, change of address notices, subscription orders, etc., to above address.

Modern Plastics issued monthly, except September when issued semi-monthly, by Breskin Publications, Inc. and Plastics Catalogue Corp., at Emmett St., Bristol, Conn. Second-class mail privileges authorized at Bristol, Conn. Subscription rates (including Modern Plastics Encyclopedia Issue), payable in U. S. currency: In United States, its possessions, and Canada, 1 year $7, 2 years $12, 3 years $17; all other countries, 1 year $20, 2 years $35, 3 years $50. Single copies 75¢ each (Show issue $1.00; Encyclopedia issue, $3.00) in the U. S., its possessions, and Canada; all other countries $2.00 (Show issue, $2.50; Encyclopedia issue $6.00). *Reg. U.S. Pat. Off.

This seed-starter kit needs only water to germinate the seeds. Holes are punched in the lid, and water poured through. The base serves as the planter box after seedlings appear. Punching of holes won't crack the lid because Campco sheet eliminates internal stress. Production costs are kept low to permit the inexpensive 49¢ sale price.

Perfect pack for the product ...with low-cost CAMPCO sheet

Low production cost is *the* big requirement for this Northrup-King Punch 'n Gro pack. Yet other requirements are equally stringent. The hole recesses must be easily punched out, but not so weak that they will rupture in shipment. The lid should also have high optical clarity, yet cannot shatter or crack during shaping. The base, too, needs to have high impact resistance, even in sections thinned for economy.

Here's how Campco know-how and materials met the requirements:

1. To maintain crystal clarity of the lid, CAMPCO acetate was recommended. Its special non-blushing formulation eliminates all clouding and discoloration.

2. To achieve high impact strength in the base, CAMPCO provided .015" gauge rubber-modified polystyrene sheets which are vacuum-formed to make the base. This permits a much thinner gauge than injection-molding, since it eliminates internal stresses. In the lid, this permits using .010" gauge acetate —necessary for punching of clean holes—because fragility is eliminated.

3. To meet the required production cost, CAMPCO worked closely with the package manufacturer—Mancato Products Corp. CAMPCO provided full technical assistance to help make forming operations as simple and inexpensive as possible. This assistance began in the design stage, and continued through development of molds and forming methods.

How Campco can help you

CAMPCO is your most complete source of plastic sheet and film—acetate, polyethylene, nylon, styrene or other materials. There are also special formulations that take easily to high-quality printing. CAMPCO can also suggest ways to adapt your designs to take advantage of economical *stock* rolls and sheets. All CAMPCO sheets come in a wide variety of sizes and gauges, and you have many patterns from which to choose. For complete details, write today.

While we do no custom fabricating, we will be glad to recommend a source of fabrication in your area.

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STYRENE • ACETATE • POLYETHYLENE • RIGID POLYETHYLENE • BUTYRATE • COPOLYMER STYRENE

Editorial

Our new issue date

For many years MODERN PLASTICS *Magazine* has been mailed to readers beginning the 20th or 21st of the month previous to date of issue. Beginning with January 1959 issue mailings will begin the 10th or 11th of the month of date of issue. Readers may, therefore, expect to receive their copies approximately three weeks later than the date to which they have been accustomed.

Why?

First, we have revamped the typography and the format of the magazine in keeping with the most modern publishing trends. Second, we are embarking on a program of accelerated physical production coupled with tighter editing to get the latest news to our readers with the shortest possible production lead time. Third, bigger books are scheduled with heavier illustration.

We could have advanced issue dates two or three days a month over the next several months, but this would have thrown the 30-day manufacturing schedule out of rhythm. So we are making the whole changeover with the January issue.

Readers are assured of an even better magazine with even later information for their use, with superior visual presentation and more easily read contents.

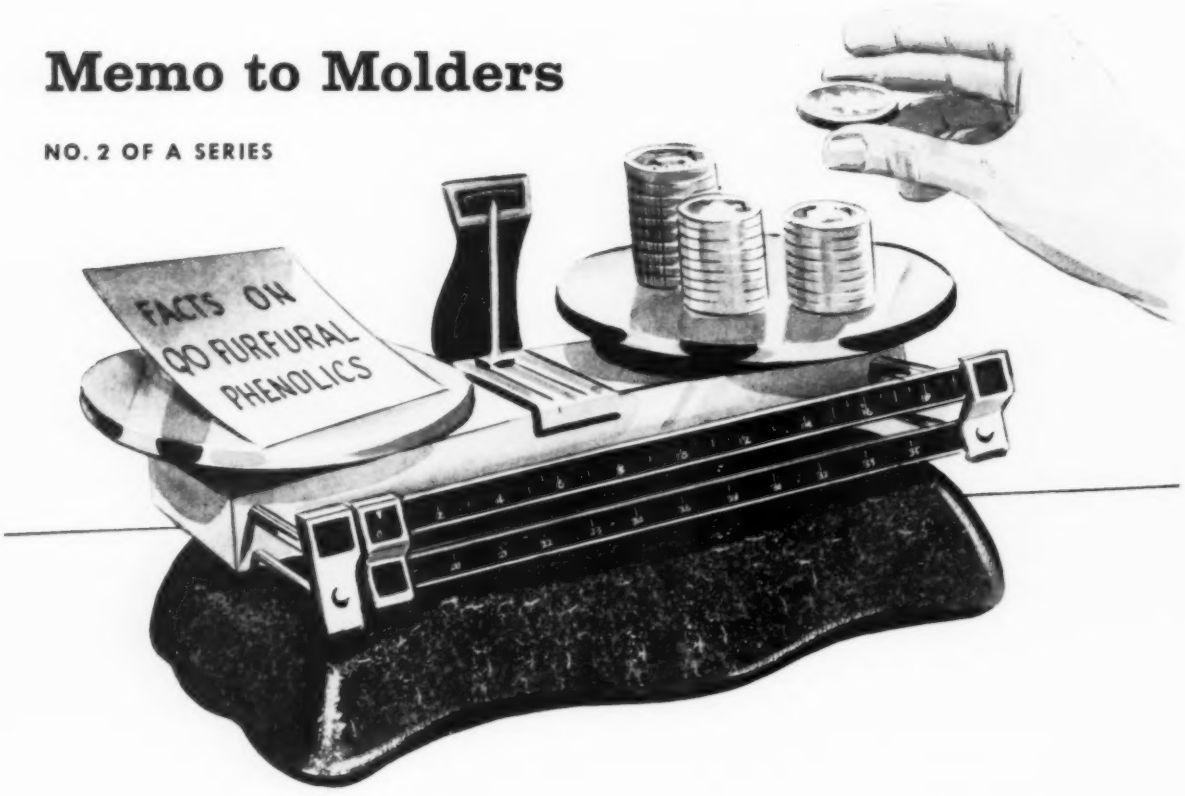
Let's have some letters

Our lead article, "Custom molders at the crossroads," deals with a vital subject and one which is most polemic. The trend toward mergers, both horizontal and vertical, parallels the swing to captive plants. What can the custom molder do to assure himself a sound future? Readers are hereby invited to comment on the subject. We'll welcome your opinions.

Printed in U.S.A. by Hildreth Press, Inc., Bristol, Conn. Member, Audit Bureau of Circulations. Member, Associated Business Publications. Modern Plastics is regularly indexed in the Applied Science & Technology Index and Industex.

Memo to Molders

NO. 2 OF A SERIES



WEIGH THE FACTS on Phenolics and QO® Furfural

See what they're worth to you

Phenolic molding powders containing QO Furfural bring EXTRA BENEFITS *and* EXTRA VALUES to molders. Depending on how your compound supplier uses furfural, he gets for you a range of useful properties not otherwise readily achieved.

That's why it pays to know these facts:

FACT 1. QO Furfural is a pure (99.5%) synthetic chemical and becomes an integral part of the molded part. It is *not* an extender . . . *not* a diluent.

FACT 2. Furfural phenolics have excellent long flow properties, yet cure quickly.

FACT 3. Furfural phenolics lend themselves well to preheating and give you fast over-all molding time.

FACT 4. Furfural phenolics give you a smooth finish and high gloss.

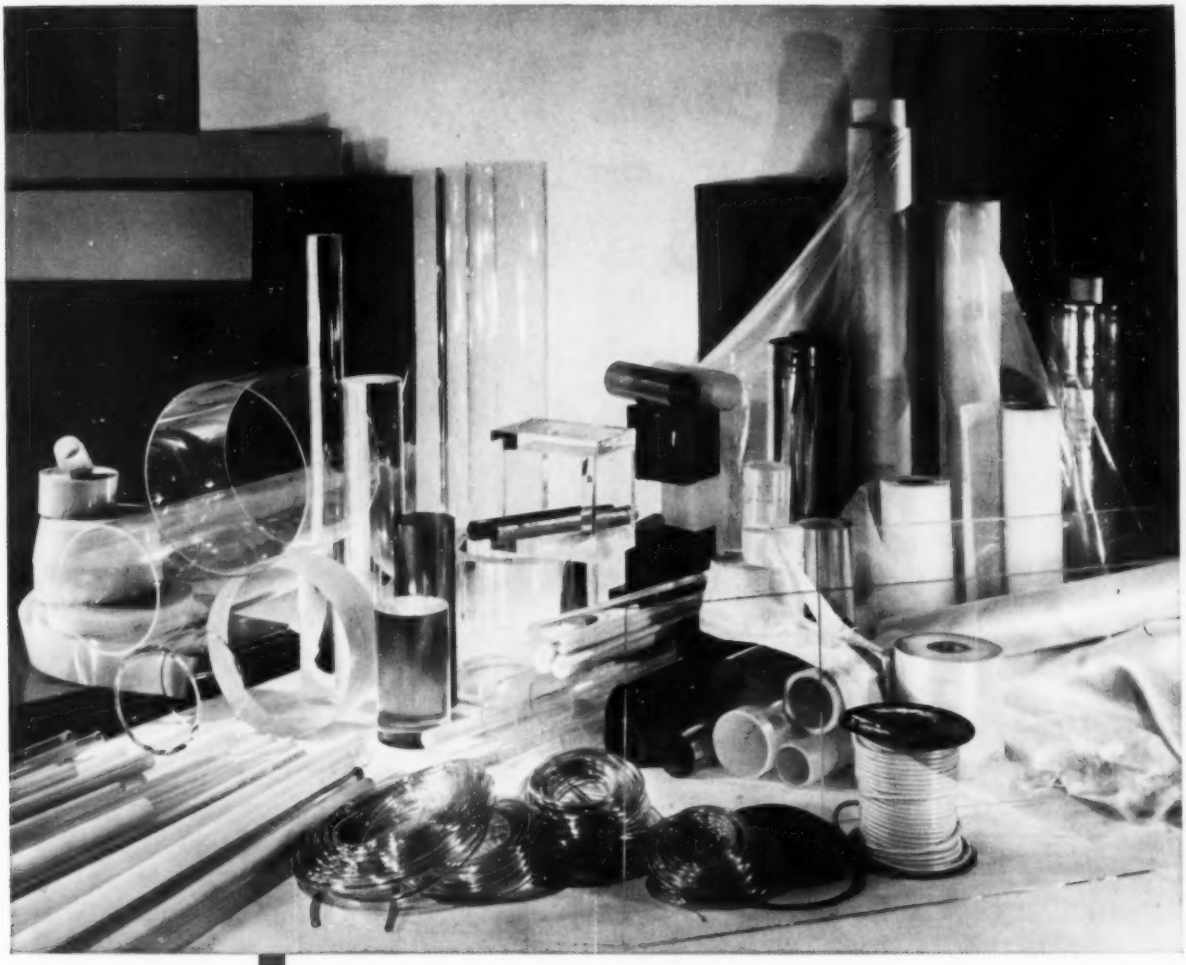
FACT 5. Mineral filled furfural phenolics mold easily for heat-resisting work.

FACT 6. Furfural phenolic moldings have excellent electrical properties and good chemical and solvent resistance.

The Quaker Oats Company does not manufacture furfural phenolic molding compounds. However, we will gladly furnish suppliers' names.

The Quaker Oats Company
CHEMICALS DIVISION
3348 The Merchandise Mart, **Chicago 54, Illinois**

CADILLAC HAS EVERYTHING IN PLASTIC



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WRITE FOR FREE BOOKLETS . . .

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Gentlemen: Please send me the following booklets:

- ☐ How to work with Plexiglas
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Company_____

Acetate Sheeting...

the perfect plastic material for blister packaging. JODA extruded acetate sheets, rolls and film in light to heavy gauges — transparent, translucent or opaque — excellent for vacuum forming. Illustrated is an outstanding example of vacuum formed blister package by VE•ALITE Plastic Corporation, Brooklyn, N. Y. Blister packaging is meeting with increased consumer acceptance — proving the adage that "Seeing is Half of Selling!"

BUTYRATE and LINEAR POLYETHYLENE available in standard sizes.

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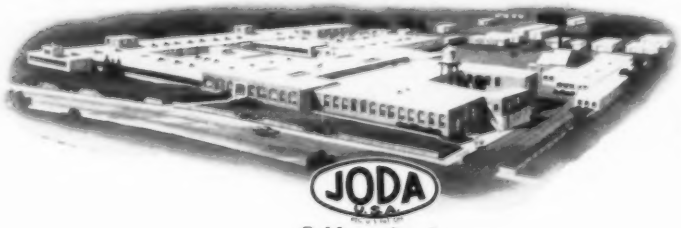

Cable — Insel

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Turn your pressing problem into a *profit operation* with an

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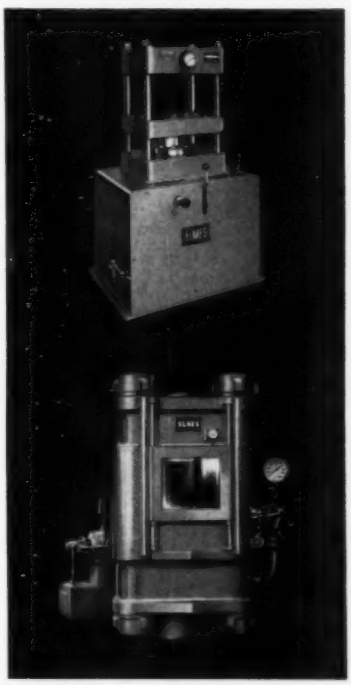
"Job-Fitted" HYDRAULIC PRESS

Hundreds of manufacturers have called on Elmes to help solve production problems involving pressure application. It's no secret that Elmes engineering is pre-eminently qualified to provide this profit-making service — to recommend *the right press for the job.*

It will pay *you*, too, to call in Elmes on your pressing problems. Maybe your answer is in one of the many standard Elmes® designs, either "as is" or with simple modification. Or, if your requirements are special, Elmes will develop a "custom-built" press to fit your needs *exactly.* This special-design function has long been an important part of Elmes' service to industry.

In any case, you'll be wise to take advantage of engineering knowledge, skill, and foresight backed by more than 60 years of leadership in specialized hydraulic service. Recommendations and cost estimates promptly supplied. See your Elmes Distributor, or write us direct.



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(For Plastics and Rubber Molding)

Pushbutton controlled, with semi-automatic time dwell cycle. Extra-large die space. Wide versatility; maximum operating ease and safety; adaptable to virtually any job. Standard capacities from 50 to 1000 tons. Special design as needed, in any required capacity.

ELMES HYDROLAIRS®

Hydraulic presses powered by shop air line . . . ideal for small-press users. Fast, low-cost production in plastics and rubber molding, laminating, etc., and for laboratory test work. Standard models in 30, 50, 75 and 100-ton capacities.

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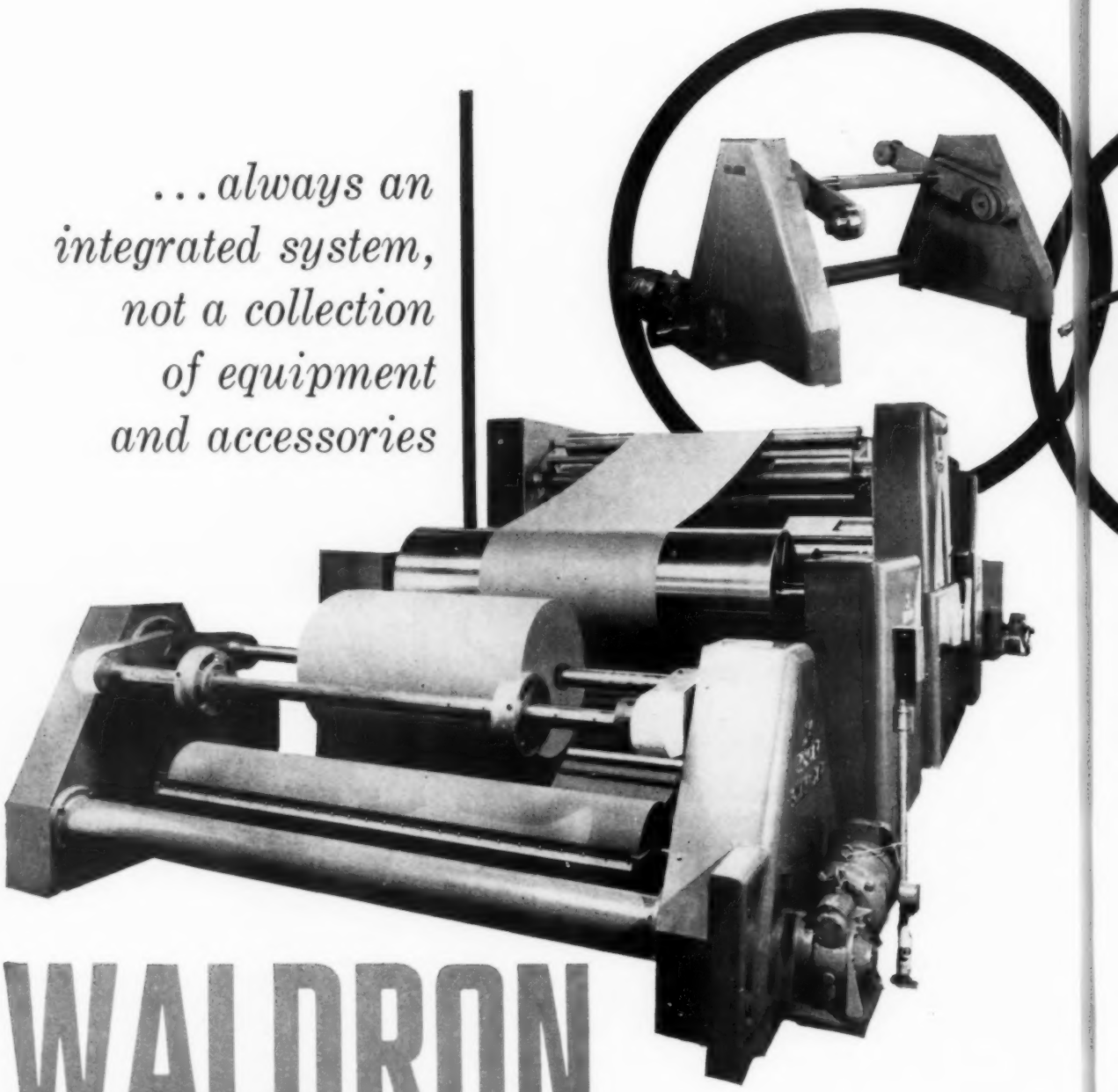
...always an integrated system, not a collection of equipment and accessories



WALDRON WEB PROCESSING

To Waldron Web Processing Engineers, the Unroll Stand with its dual supply rolls... its splicing device... its tension control, is just as important a factor in the Web Processing System as the coater, impregnator or embossing unit itself.

To Waldron, the Winder also calls for just as much thought and care... and the Pull Roll... and the Cooling Section.

Conceivably, even the experience carried down through more than 130 years of web process engineering is playing a major role in seeing to it that *all* component parts are properly engineered and integrated into the system. Certainly, the experience gained over the past fifty years, when so many of the synthetics have come on the market, has been invaluable in the development of special Waldron Web Processing Systems for each of the many materials.

It is this kind of thinking and kind of experience that would focus on *your* web processing requirements. Should you select Waldron as your source of supply for systems to do coating, embossing, impregnating, saturating, printing, laminating, yours would be a custom made job.

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OFFER SO MANY OUTSTANDING DESIGN FEATURES CONTRIBUTING TO *MORE PROFITABLE* PLASTICS EXTRUSION...

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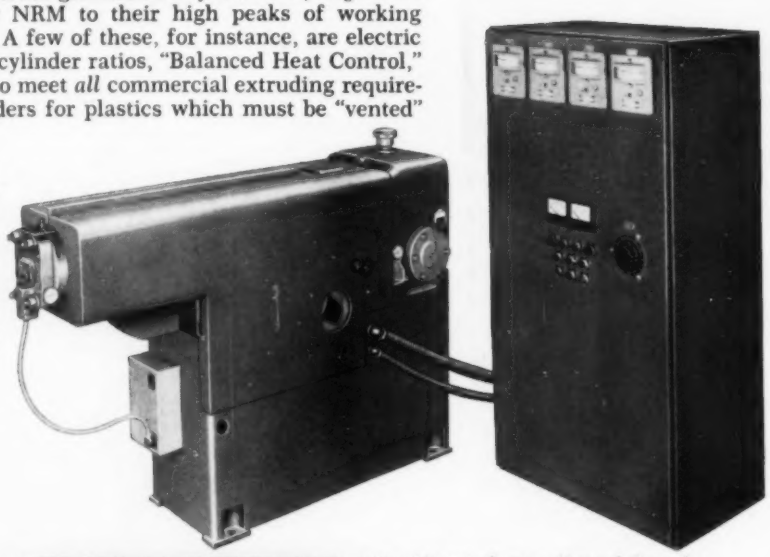
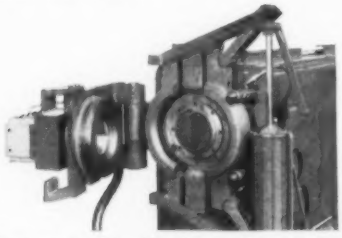
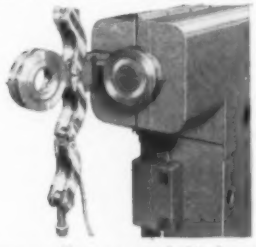
Take them all together . . . the features mentioned here, plus the *many* not mentioned, and you have the world's finest Extruder, chosen by large and small plastics producers and processors the world over to increase profit margins and reduce operating costs. Let us send *you* performance data and engineering details on NRM Thermoplastic Extruders.



NRM 2½" Induction Heated Extruder

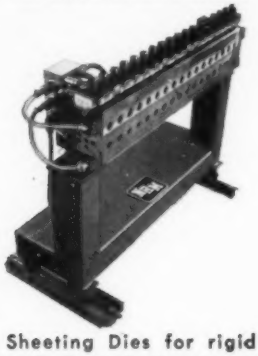


Automatic Die Heads on large NRM Extruders are opened and closed "at the touch of a lever" substantially increasing available production time.



Even manually operated die heads are opened and securely closed in seconds, when equipped with NRM Handy Clamps with only one swing bolt to loosen or draw up.

Heavy-duty, over-size thrust bearings of special design assure long bearing life . . . make possible large, high performance extruders like the NRM 15" Model which has a transmission of 800 h.p. capacity.



NRM Sheeting Dies for rigid and elastomeric sheet plastic set completely new highs in the ruggedness of construction so important to close tolerance sheet extrusion. Gauges from .040" to .500" and widths up to 48" and larger are no longer a problem.

2024-A

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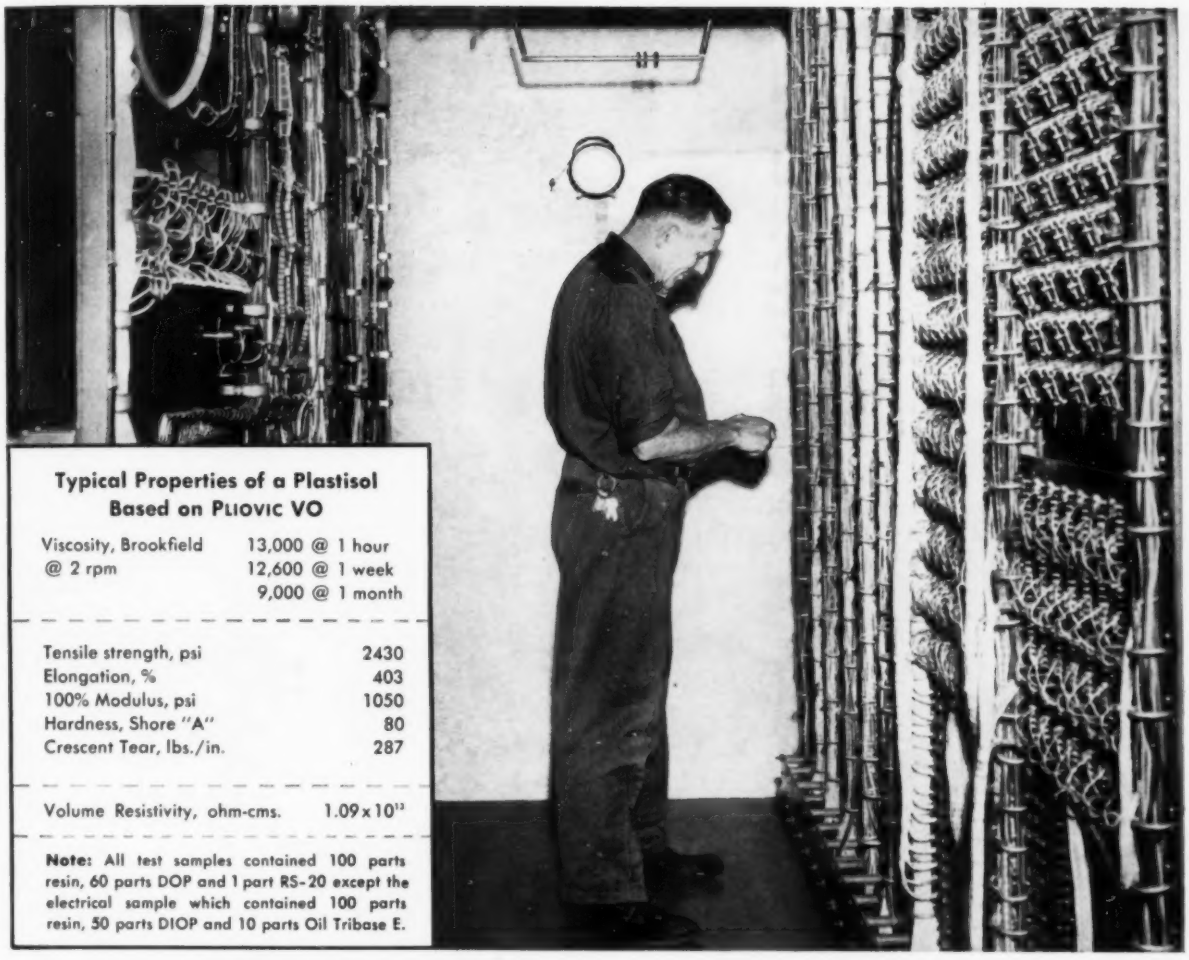

Typical Properties of a Plastisol Based on PLIOVIC VO

Viscosity, Brookfield @ 2 rpm	13,000 @ 1 hour 12,600 @ 1 week 9,000 @ 1 month
Tensile strength, psi	2430
Elongation, %	403
100% Modulus, psi	1050
Hardness, Shore "A"	80
Crescent Tear, lbs./in.	287
Volume Resistivity, ohm-cms.	1.09×10^{13}

Note: All test samples contained 100 parts resin, 60 parts DOP and 1 part RS-20 except the electrical sample which contained 100 parts resin, 50 parts DIOP and 10 parts Oil Tribase E.

New—and purely superior!

If you're looking for something new and different in dispersion resins, particularly for use in electrical applications, you can stop right now. For in new PLIOVIC VO, we have just that.

PLIOVIC VO is a straight polyvinyl chloride resin of exceptional purity. It is designed and made for use in plastisols and organosols for electrical applications, for rotational and slush molding, for metal coatings and for dip coatings.

Compounds based on PLIOVIC VO exhibit the following characteristics: 1. Extremely low initial viscosity. 2. Outstanding shelf stability. 3. Superior electrical properties. 4. Excellent heat stability. 5. Good physical properties. 6. Exceptionally low water absorption. 7. Good film clarity.

Plastisols made with PLIOVIC VO are effectively protected against heat and light with small amounts of economical zinc-type stabilizers. They also are readily deaerated to assure uniform cross sections. And they exhibit a very desirable, dry, nongreasy feel. For full details, including the latest *Tech Book Bulletins*, on the new PLIOVIC VO, the unique PLIOVIC AO, or their blends, just write to: Goodyear, Chemical Division, Akron 16, Ohio.

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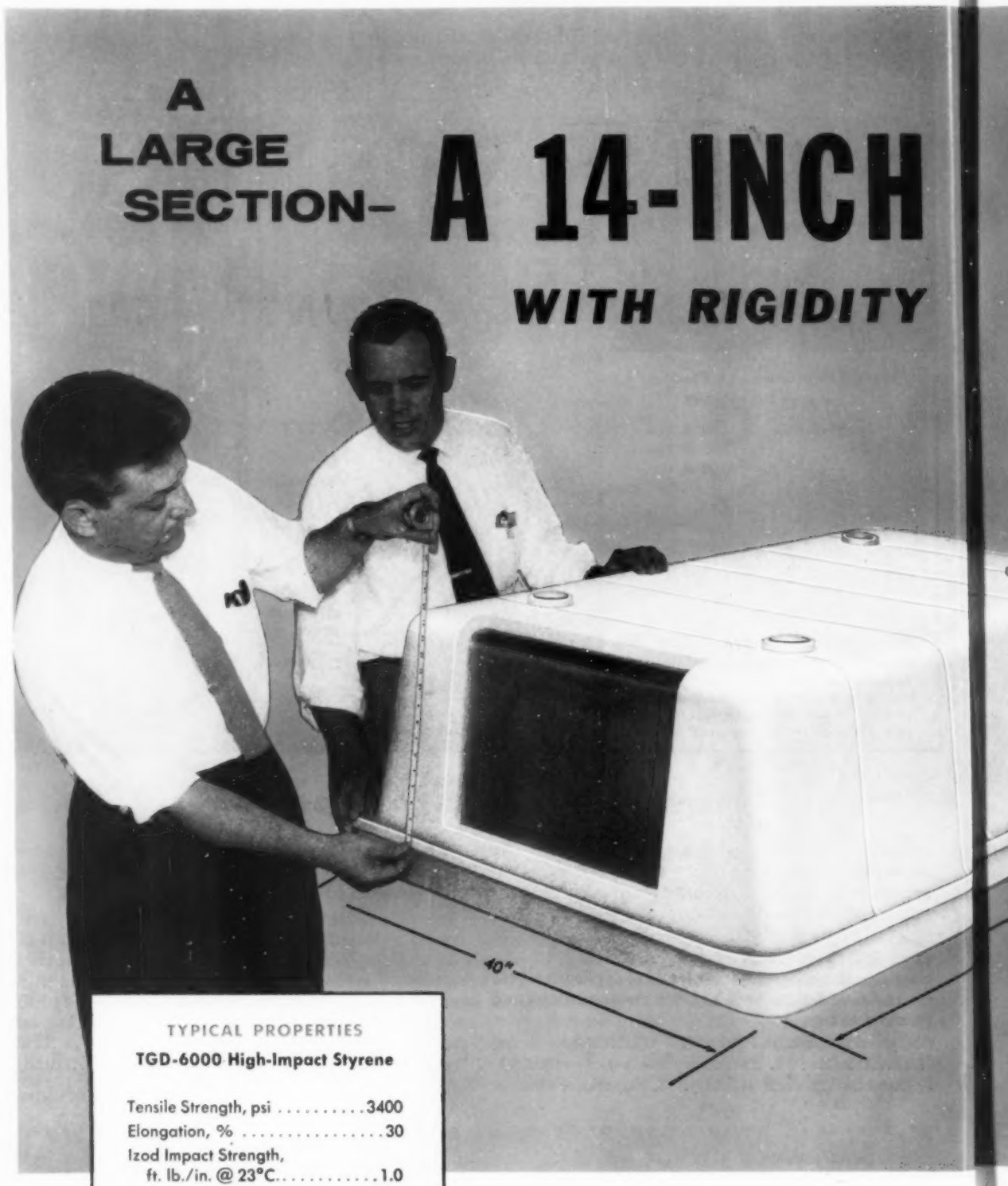


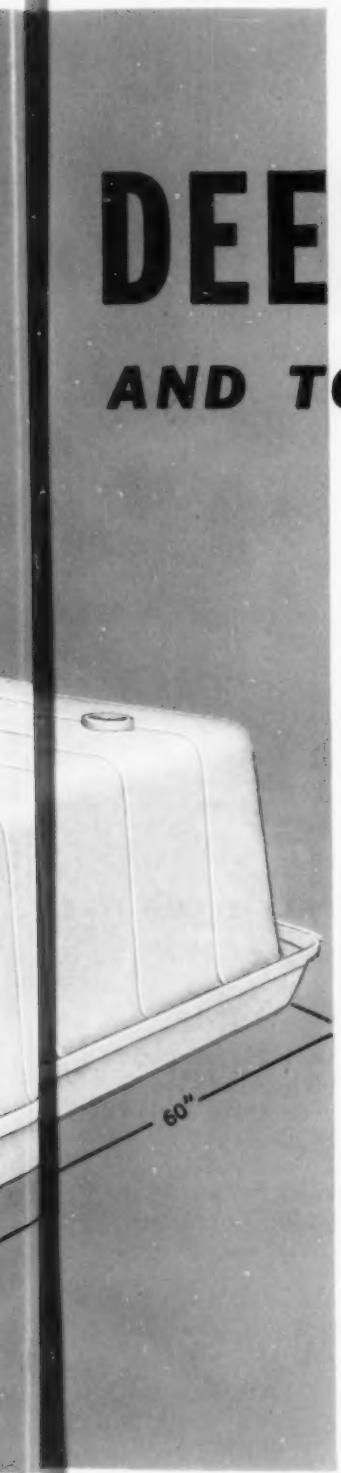
TYPICAL PROPERTIES

TGD-6000 High-Impact Styrene

Tensile Strength, psi	3400
Elongation, %	30
Izod Impact Strength, ft. lb./in. @ 23°C.	1.0
@ 0°C.	0.85
Modulus of Elasticity in Flexure, psi x 10^5	3.6
Flexural Strength, psi	8000
Hardness, Durometer, D	80

BAKELITE
BRAND

2037



DEEP DRAW—

AND TOUGHNESS MAINTAINED!

How could *your* product or part be made better by a BAKELITE Brand Plastic? Consider the all-around advantages gained by Almor Corporation, Van Dyke, Mich., for its new line of produce display tables . . .

A 30% saving (over former materials) was an immediate result of Almor's change to BAKELITE Brand TGD-6000 high-impact styrene. This change followed extensive tests which proved that the large table sections could be vacuum-formed directly from sheets 38½" x 58" x 125 mil., with virtually no loss in strength and rigidity, *even when deep-drawn to 14 inches!*

Besides a high degree of formability, TGD-6000 provides surface hardness and high gloss for modern, easy-to-clean appearance and maintenance—with uniform, integral color free from streaking.

For technical data on TGD-6000 or any of the other BAKELITE Brand Styrenes, contact your Technical Representative or write Dept. LC-37H.

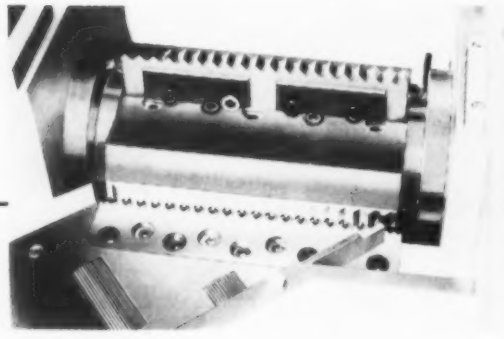
Completed "Almor" display table for large super-markets consists of a 3-inch tray top and a 14-inch deep base, both vacuum formed of BAKELITE Brand TGD-6000 Styrene. The 14-inch draw is done with a plug assist. Kal Plastics, Beaverton, Michigan extruded the sheet of BAKELITE Brand TGD-6000 Styrene which was vacuum formed by Imperial Industries, Wayne, Michigan. Table designed by Irving Stollman.

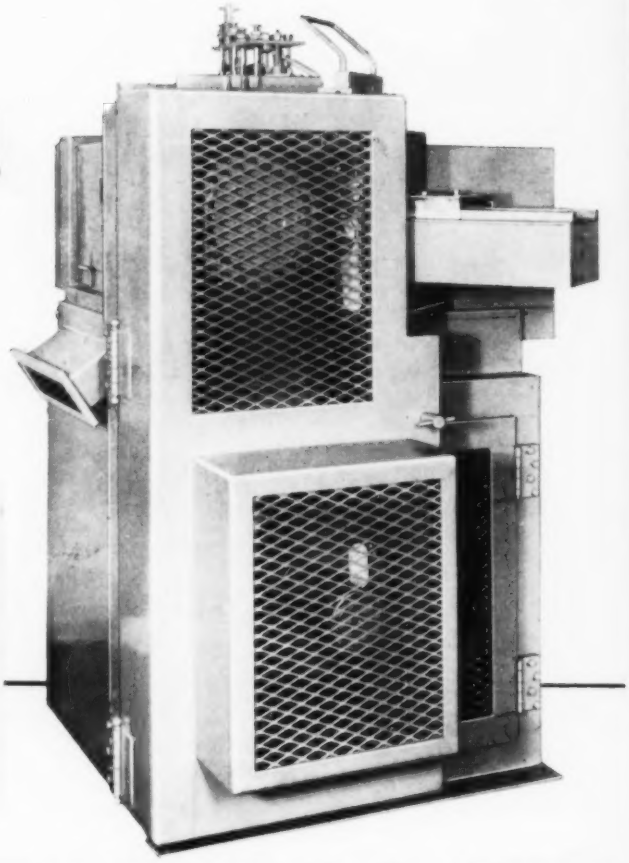
TGD-6000
High-Impact Styrene

Product of UNION CARBIDE *Corporation*

UNION CARBIDE PLASTICS COMPANY, *Division of Union Carbide Corporation*, 30 East 42nd Street, New York 17, N. Y.
In Canada: Bakelite Company, Division of Union Carbide Canada Limited, Toronto 7.
The terms BAKELITE and UNION CARBIDE are registered trade-marks of UCC.

Cumberland
"Stair-Step" DICING MACHINE





PART OF THE COMPLETE LINE OF CUMBERLAND PELLETIZERS, BESIDE THE PRESS AND CENTRAL GRANULATING MACHINES, DICERS, CHOPPERS AND PRE-BREAKERS

LARGE THROAT GRANULATORS

Minimum floor area needed. Five new throat sizes available. 7"x10", 8½"x12", 8½"x16", 12"x16", 12"x20".

CUMBERLAND PELLETIZING MACHINE

New feed roll mechanism provides better control of extruded strands of plastic materials. Cuts cubes or pellets 1/32" to 1/2". 14" and 24" openings.

Cumberland
ENGINEERING COMPANY, INC.

316-7

PERFECT RESULTS Exclusive 45° feed produces perfect cubes or rectangle pellets in sizes 1/16" to 1" in one severing operation — rotor knives cutting against one stationary knife.

VERSATILITY Dices wide range of extruded or milled thermoplastic ribbon, or sheet stock. TWO standard sizes to accommodate 7" or 14" stock. Special sizes built to order.

QUALITY CONSTRUCTION Ruggedly built. All surfaces contacting plastics materials are of corrosion resistant metals, stainless steel or chromium plated.

Watch for future ads featuring other outstanding Cumberland machines, and write for Bulletin 260.

DEPT. 1 • BOX 216, PROVIDENCE 1, RHODE ISLAND

Direct factory engineering assistance available throughout North America from sales offices in Providence, New York, Cleveland, Chicago and Los Angeles

FOREIGN LICENSEE — BURTONWOOD ENGINEERING COMPANY, LTD.
Burtonwood, Warrington, Lancashire, England
Sole Manufacturers and Distributors outside North and South America

- *quality*
- *service*
- *dependability*
- *savings*

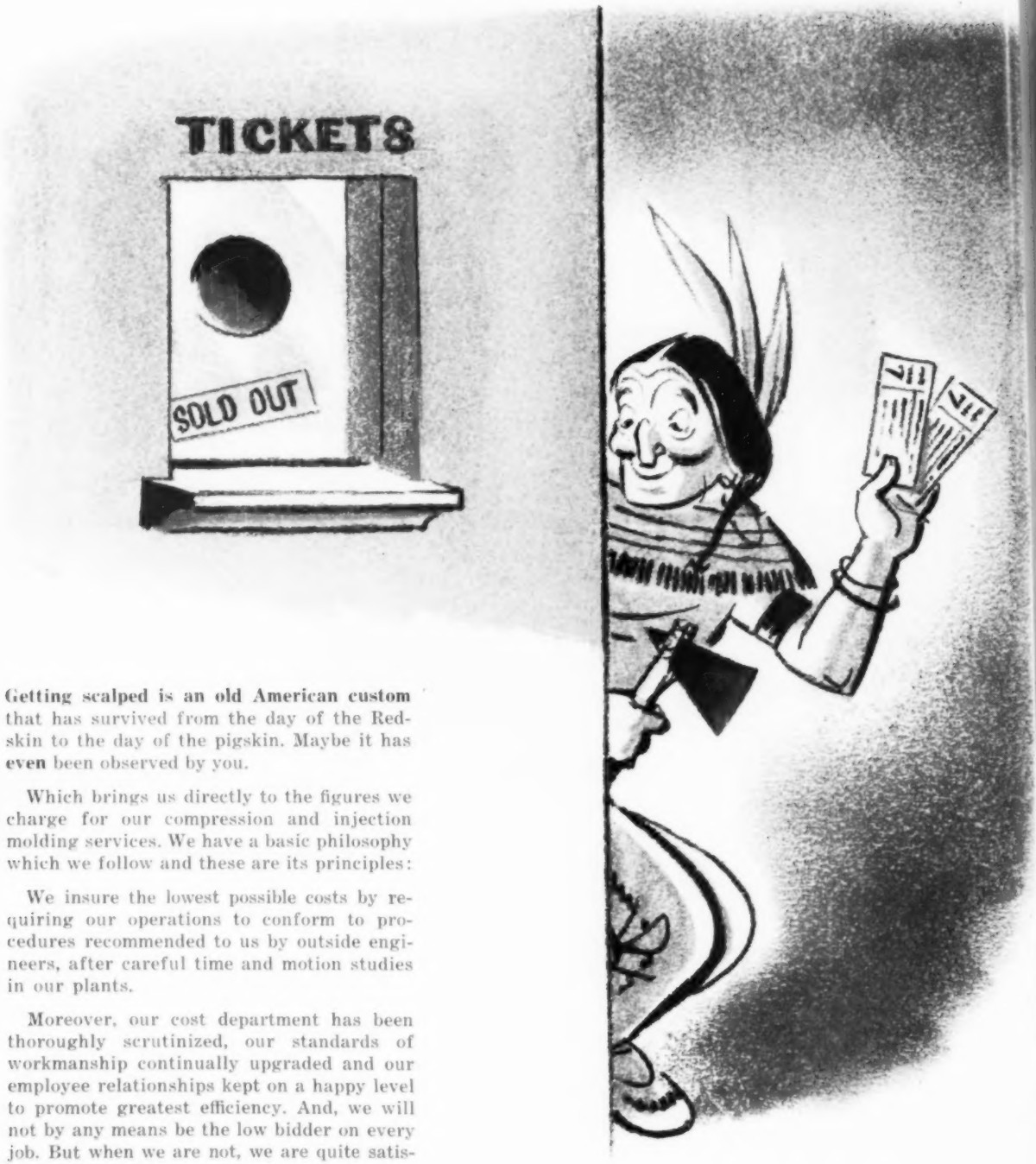
GERING

MOLDING COMPOUNDS

- **VIRGIN MOLDING COMPOUNDS**—Vinyl, Polyethylene, Acetate, Polystyrene, Impact Styrene
  —**"COLOR COMPOUNDING SPECIALISTS"**—Your orders formulated to exact color, flow and physical properties specifications.
- **REPROCESSED MOLDING COMPOUNDS**—Polyethylene, Vinyl, Polystyrene, Acetate, Nylon; Acrylics, Impact Styrene, Butyrate
  —**"CUT COSTS WITHOUT SACRIFICING QUALITY"**—Supplied in uniform, dust-free pellets . . . perfectly matched from first bag to last.
- **RIGID QUALITY CONTROL • COMPETITIVELY PRICED • SPEEDY DELIVERY**—no matter how large your order! Write Us About Your Specific Needs Today!

GERING
Molding Compounds

Gering Products, Inc., Kenilworth, N.J. · Sales Offices: 5143 Diversey Ave., Chicago 39, Ill. · 424 Chevy Chase Rd., Mansfield, Ohio · 103 Holden St., Holden, Mass.



Getting scalped is an old American custom that has survived from the day of the Redskin to the day of the pigskin. Maybe it has **even** been observed by you.

Which brings us directly to the figures we charge for our compression and injection molding services. We have a basic philosophy which we follow and these are its principles:

We insure the lowest possible costs by requiring our operations to conform to procedures recommended to us by outside engineers, after careful time and motion studies in our plants.

Moreover, our cost department has been thoroughly scrutinized, our standards of workmanship continually upgraded and our employee relationships kept on a happy level to promote greatest efficiency. And, we will not by any means be the low bidder on every job. But when we are not, we are quite satisfied not to get it.

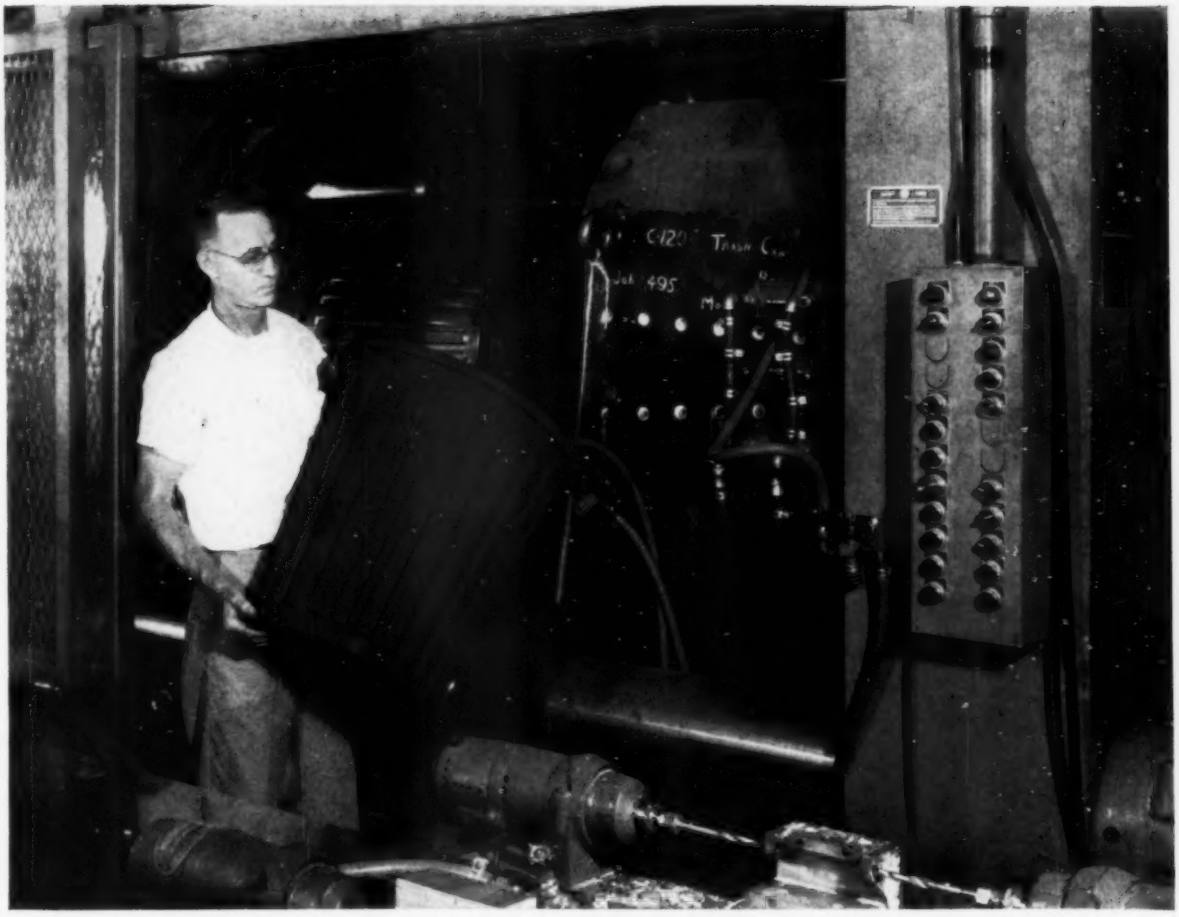
The result of this policy has been to guarantee our customers the finest in molded plastics at the **fairest** and **most reasonable** prices.

And this is the truth. Honest Injun.

BOONTON MOLDING CO.

BOONTON, NEW JERSEY

New York Metropolitan Area—Cortlandt 7-0003
Western New York Area—Alden 7134
Connecticut Area—Woodbine 1-2109 (Tuckahoe, N. Y.
Philadelphia Area—Pioneer 3-0315



The H-P-M "300" is ideal for filling deep, thin-walled sections or large areas rapidly. The refuse container illustrated above is typical.

Big, New H-P-M 300 Oz. Injection Molder goes to work For Columbus Plastic Products, Inc.

Molding big, new colorful refuse containers has not been a problem for Columbus Plastic Products since the installation of the new H-P-M Model 1500-P-300. These 24 gallon containers, with deep, long stroke requirement use only a portion of the available injection capacity. Cycle time is much faster than originally thought possible. Just look at the potential for this new H-P-M preplasticizing giant in terms of production capacity . . .

- **1500 tons clamping force**
- **300 oz. capacity per shot**
- **A Completely new preplasticizer with a capacity of 400 lbs. of material per hour**
- **Mold mounting space—48" x 72"**
- **Daylight—106" • Stroke—60"**

Here's real production capacity, with all the advanced features of the new, super-productive line of H-P-Ms. Plan for more profits by planning with H-P-Ms. Send for the facts on the most comprehensive line of plastic molding machines today.

HPM

THE HYDRAULIC PRESS MFG. COMPANY

A Division of Koehring Company
Mount Gilead, Ohio, U.S.A.

H922

hr

Industry usage* endorses

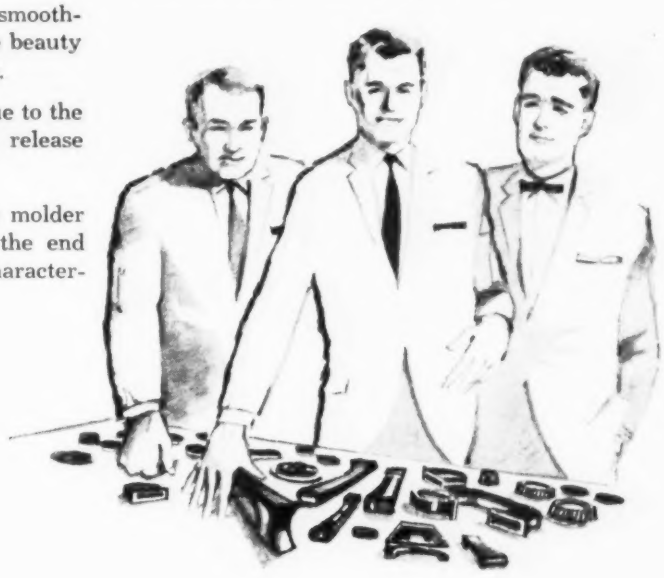
PLENCO HEAT RESISTING PHENOLIC COMPOUND 349

FOR APPLIANCE handles, knobs and trim that must have the highest possible heat resistance, molders recommend and leading manufacturers specify Plenco 349 HR. because:

- It possesses a heat resistant range up to 500°F.
- Offers superior surface finish, smoothness and lustre that adds to the beauty and saleability of the appliance.
- Provides efficient production due to the fast cure and excellent mold release characteristics of the material.
- Assures dependability: To the molder because of its uniformity—to the end user because of its molded characteristics.

*We estimate that (since its introduction in 1952) eighty to one-hundred million parts have been molded from Plenco 349 HR. . . . and for many of the best-known names in the appliance industry.

Investigate the good reputation of this excellent material; it will serve you well.



PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

IF PHENOLICS CAN DO IT—

plenco

CAN PROVIDE IT...

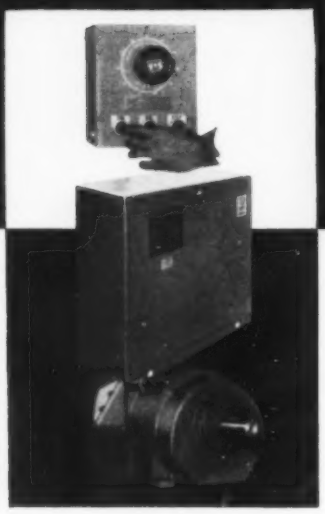
already-made or specially-made

PLASTICS ENGINEERING COMPANY

Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins

Photo courtesy Radix Wire Co.



PUT MORE PRODUCTIVITY INTO YOUR EXTRUDER WITH A RELIANCE V*S DRIVE

The productivity of an extruder depends upon how many shapes and forms it can turn out, and how many types of materials it will extrude. A Reliance Variable Speed Drive gives you more flexibility and puts maximum productivity into your extruder.

With the wide speed range of a V*S Drive, a single extruder can accommodate a variety of dies. Speeds can be automatically controlled or manually adjusted.

The unique horsepower and torque characteristics of a Reliance Drive can handle a broad assortment of materials. Anything from rigid vinyls to pliable polyethylene can be extruded on a single machine with a V*S Drive!

To put more productivity and profitability into your next extruder, be sure to specify a Reliance V*S Drive when you order.

For further details contact your local Reliance representative, or write today for Bulletin No. D-2506. D-1588A

MASTER REEVES R RELIANCE ELECTRIC AND ENGINEERING CO.

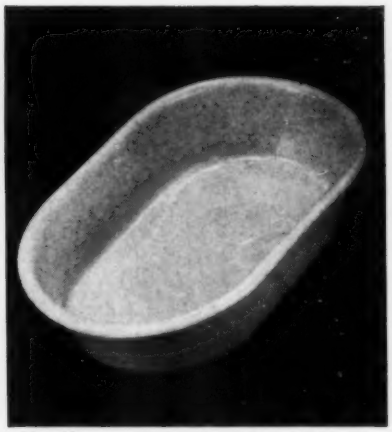
DEPT. 1511-A, CLEVELAND 17, OHIO

CANADIAN DIVISION: TORONTO, ONTARIO

Sales Offices and Distributors in Principal Cities

Rubbermaid uses "Poly-Eth" 1709 to make this laundry basket.

Plastray uses "Poly-Eth" 1709 to make refrigerator food containers.



Yardley uses "Poly-Eth" 1709 to make this baby bath.

New "Poly-Eth" 1709 Resin For Greater Stiffness . . . Better Gloss:

Here's why these 5 major houseware producers have switched to this Type II density resin:

The first of a new series of .928 density molding resins, "Poly-Eth" 1709 is working wonders in the plastics industry. One enthusiastic user, Como Plastics, Inc., of Columbus, Ind., reports "Poly-Eth" 1709 gives excellent color dispersion and finish. Most important, it has let them increase their shots approximately 10% per hour!

A product of Spencer Chemical Company, new "Poly-Eth" 1709 gives users three important advantages:

1. Faster cycle time. With a melt index of 30, "Poly-Eth" 1709 provides excellent flow, even in intricate cavities. (Other "Poly-Eth" resins are available with a lower melt index for different operating conditions.)

2. Higher gloss. The shiny gloss obtained with this new resin adds to a product's sales appeal, without adding to the price. "Poly-Eth" 1709 gives a brilliant finish, yet costs no more than other resins that produce less gloss.

3. Greater stiffness. You may discover that a thinner wall of "Poly-Eth" 1709 can do the same job as a thicker wall of another resin.

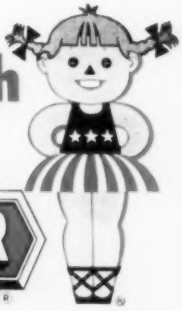
But that's not all! "Poly-Eth" 1709 is also available as a lubricated compound for easier ejection of parts and easier nesting.

For complete information on new "Poly-Eth" 1709 resin, write to Spencer Chemical Co., Dwight Bldg.; Kansas City 5, Mo.

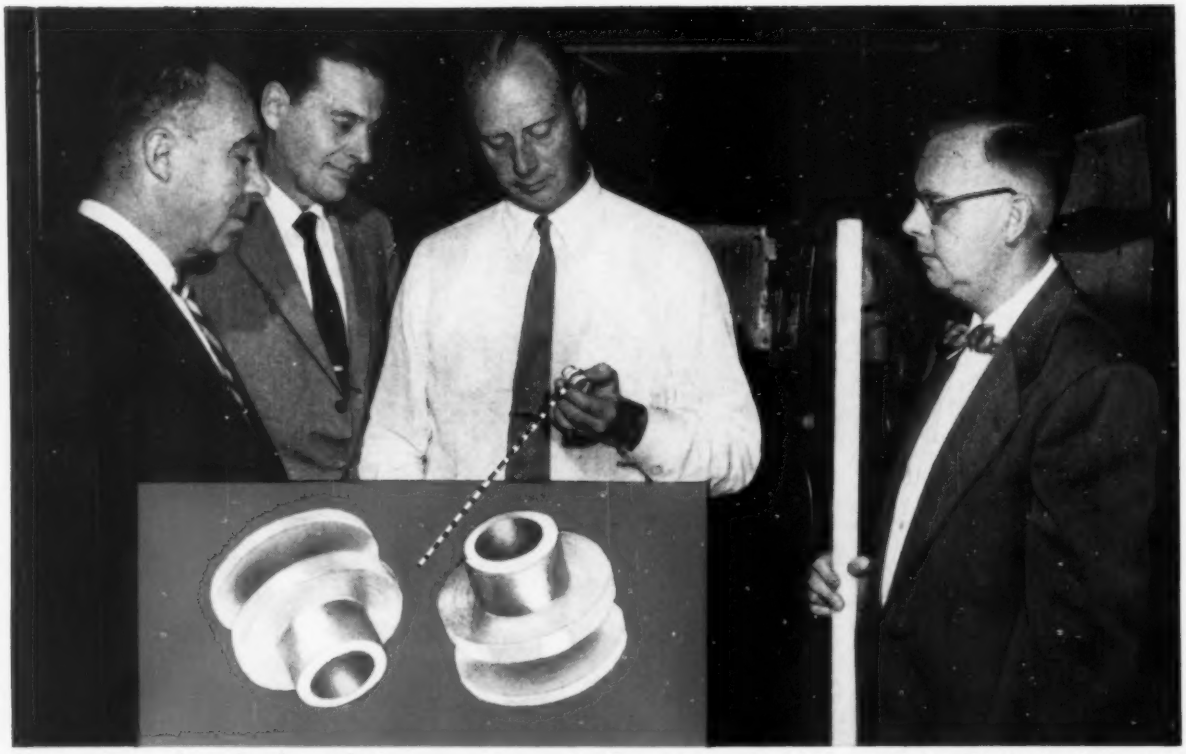
J. A. Gits Plastic Corp. uses "Poly-Eth" 1709 to make this pitcher.

Como uses "Poly-Eth" 1709 to make this all-purpose basket.

Poly-Eth by SPENCER



SPENCER CHEMICAL COMPANY
Dwight Bldg., Kansas City 5, Mo.



More units per foot of nylon rod—that's one of the many benefits Charles DeMartin (third from left), President of General Screw Products, got by switching to the new, longer Danco Rod made of Spencer Nylon. Finished nylon part is used in lens carriage assembly of a Haloid Xerox® photocopying machine.

Leading user of nylon rod reports:

150% Less Handling...5% Less Bar-End Loss

How new 10-foot Danco Rods made of Spencer Nylon help General Screw Products turn out more parts at less cost:

"Bigger and better" may be general terms, but they apply perfectly to the new 10-foot nylon rod now being marketed by Danielson Manufacturing Company of Danielson, Conn. Using Spencer Nylon, the Danielson Company has developed a nylon rod that is 2½ times as long as the 4-foot rod other companies produce!

One of the first to cash in on the many advantages offered by the new Danco Rod was General Screw Products of Rochester, N. Y. The 10-foot rod of Spencer Nylon pays off for them three ways:

Since they don't change lengths so often now when machining parts, there is **(1)** less machine down-time, **(2)** less handling, and **(3)** more unit production per man-hour of work. But that's not all!

With more usable work surface per rod, there is less bar-end loss. General Screw Products reports that the Danco Rods of Spencer Nylon give them a saving of one foot of material in every twenty feet used! Also, the rods of Spencer Nylon have proved to have greater tenacity than the rods previously used. The rods have a finish "equal to or better than" the rods formerly used, which General Screw Products had considered to be the best available for their machine operation—until the Danco Rods of Spencer Nylon were developed!

You, too may discover that the special properties of Spencer Nylon make it the ideal plastic for your nylon needs. For complete information, write: Spencer Nylon, Spencer Chemical Company, 600 Dwight Bldg., Kansas City 5, Missouri.

SPENCER NYLON

SPENCER CHEMICAL COMPANY

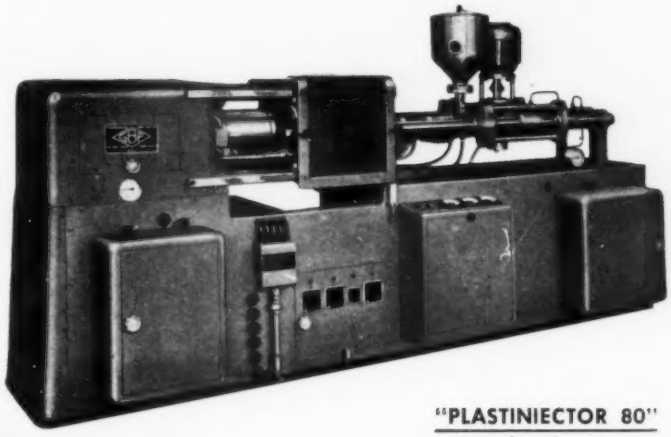
GENERAL OFFICES: DWIGHT BUILDING, KANSAS CITY 5, MISSOURI

NEW DEVELOPMENT

DYNAMIC PREPLASTICIZER
FAST INJECTION SPEED

G. B. F. "PLASTINIECTOR"
world patent

moulds better
moulds faster
self-contained
fully automatic
oil hydraulic



"PLASTINIECTOR 80"
capacity: 4 oz.
7 c. inch

Other sizes available:
2- 6- 11 and 18-oz.

GBF

COSTRUZIONI MECCANICHE s.r.l.
BRESSO (Milano)—**Italy**

World Distributors:

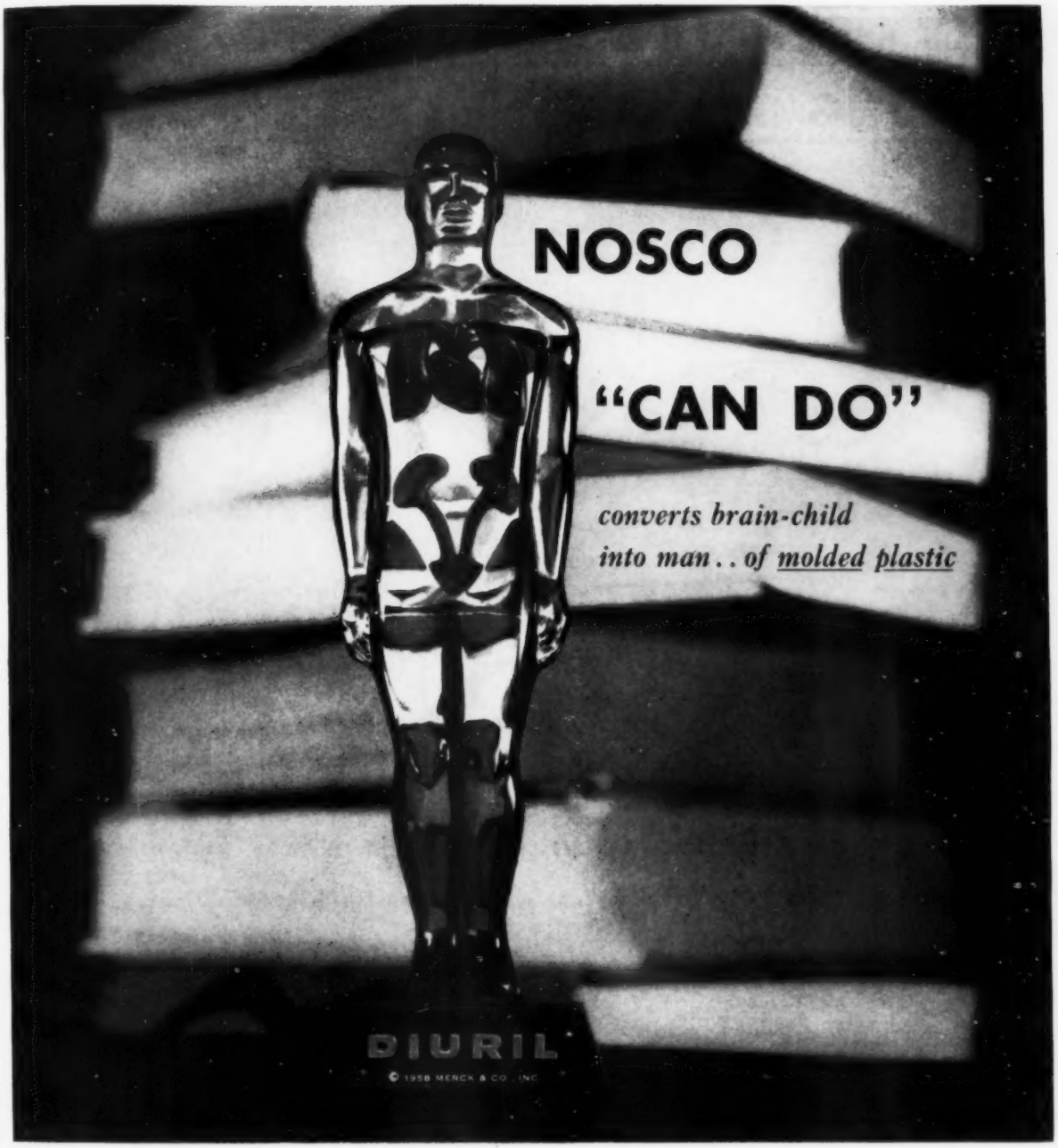
COVEMA s.r.l.—MILANO (Italy)

Via Fontana 5—tel. 705.735—709.356
cables: Covema—Milano

ADVANTAGES:

1. Uniform plasticizing and high injection rate at lower temperature.
2. Total pressure directly on the material.
3. Extremely fast injection.
4. Exact weight of each shot due to the volumetric injection of the preplasticized material.
5. Low injection pressure.
6. No change of container for the various materials and colours.
7. Automatic operation cycle regulable by timers and continuously controlled.
8. Parts better in quality and uniform in size, also on large areas and on thin walled sections.
9. Hourly plasticizing capacity:

2 oz.	4 oz.	6 oz.	11 oz.	18 oz.
20 lbs.	30 lbs.	49 lbs.	88 lbs.	145 lbs.



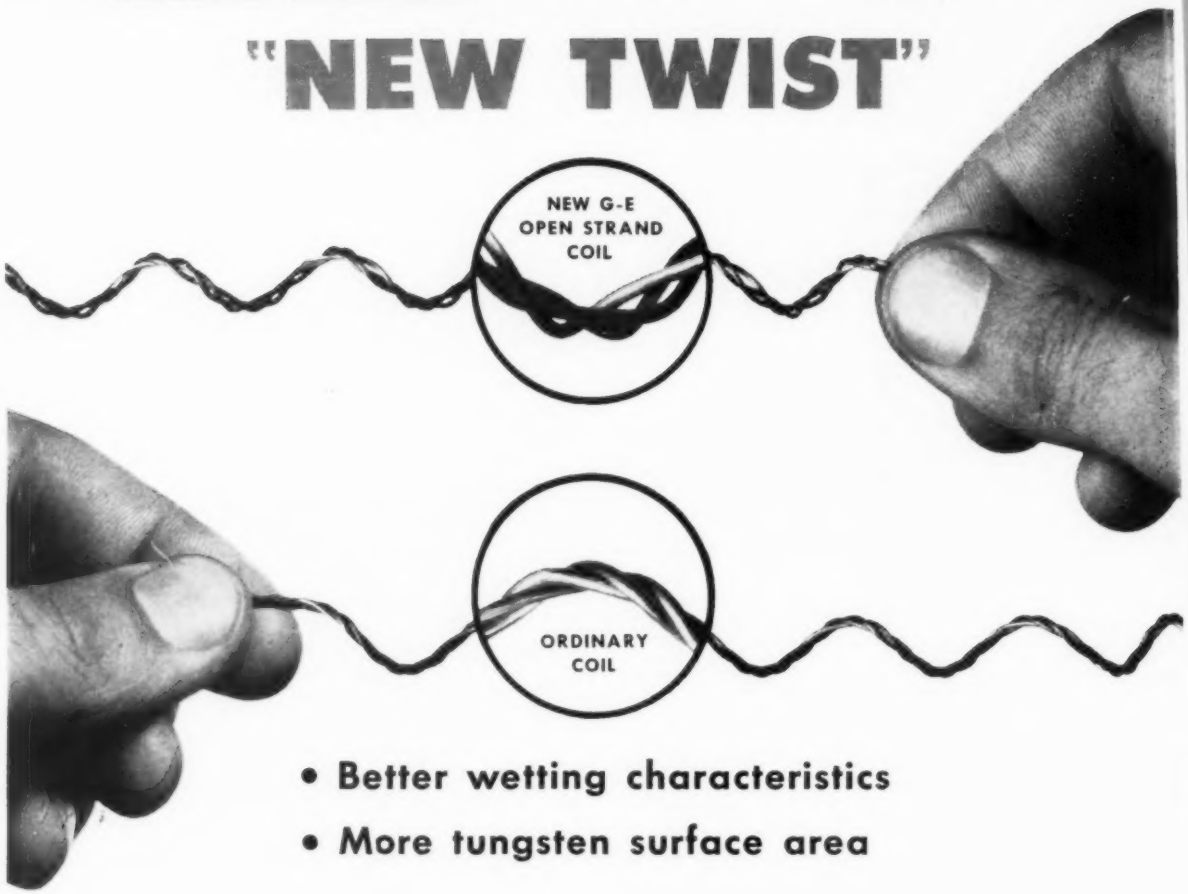
This was the brain-child of Merck Sharp & Dohme, pharmaceutical manufacturer. They showed Nosco a sketch and said "Make us a man, six inches tall: a small plastic figure to introduce doctors to 'DIURIL,' a new drug which controls the body's fluid content." The figure had to be fluid-filled and transparent to show the internal organs.

How did Nosco "Can Do" make a man? First we built a prototype by hand, then refined the design many times to facilitate volume production. The figurine is molded of cellulose propionate plastic in a Nosco-designed, two-unit mold. Each finished figure contains five parts. Nosco's finishing department painted the tiny heart, lungs and kidneys, hot-stamped the trade name, cemented the internal organs, assembled the front and back body sections, filled the figure with fluid to a pre-specified level, cemented the plug in place, packed both individual and shipping cartons . . . and we had our man! *Rate of assembly: 3000 per shift!*

The toughest part of Nosco's job was to prevent leakage. Here's how successful we were: Nosco quality control delivered over 99.9% non-leaking, *perfect* pieces. Nosco likes tough jobs . . . likes to turn *your* brain-child into reality in practical plastics. For more information about Nosco "Can Do," just write or call.

NOSCO plastics, inc. · erie 5, pa. *World's largest injection molding plant*

NEW OPEN STRAND DESIGN GIVES G-E LONG GRAIN TUNGSTEN COILS A "NEW TWIST"



- **Better wetting characteristics**
- **More tungsten surface area**

ATTENTION VACUUM METALLIZERS: General Electric's new "Open Strand" Coils now have a special weave that presents better wettability characteristics—thereby reducing "balling up" which causes hot spots. This new see-through design also provides at least 25% more available surface area for evaporating. (This means you can increase aluminum loading capacity.) *All these things mean lower coil costs for you.*

65-80% MORE SHOTS. Perfection Finishing Co., Wauseon, Ohio, tested and evaluated the new General Electric "Open Strand" Coils—and Mr. R. G. Williams, president of the company, reports: "General Electric's new 'Open Strand' Coil gave us 65 to 80% more shots than we were getting with regular strand coils."

PROVE IT YOURSELF! Order a test lot of G-E "Open Strand" Coils (available in coil form only), and made to your own design. Conduct an evaluation program under the same working conditions as your present coils are operating. The results will speak for themselves. For more information, call your G-E sales representative, or write: General Electric Co., Lamp Metals and Components Dept. MP-128, 21800 Tungsten Road, Cleveland 12, Ohio.

IMPORTANT! The extra benefits of the "Open Strand" design are in addition to the inherent metallurgical advantages of General Electric "Long Grain" Tungsten developed and used in all G-E vacuum metallizing coils—both "Open Strand" and ordinary.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NOW AVAILABLE
to the Plastics Industry

the MOST COMPETITIVE LESTER EVER BUILT!

MAKE YOUR OWN COMPARISON
FILL IT IN...and see for yourself

L-225-6/9 oz.

BASIC SPECS	6/9 oz. LESTER	Any other machine
STROKE, ADJUSTABLE . .	16" to 8"	
DRY CYCLE 8" Stroke 16" Stroke	4.2 secs. 5 secs.	
DAYLIGHT	38"	
CLAMPING TONNAGE*	225 tons	
PLASTICIZING CAPACITY General Purpose Styrene	150#/hr.	
SHOT SIZE SINGLE . Styrene DOUBLE .	6 oz. 9 oz.	
MOLD CLEARANCE . . Between Beams	20" H x 17⅜" V	

*Certified by SPI Test Method

★ We invite you to test your own molds in the 6/9 oz. Lester to see what it can do for you.

These BONUS FEATURES ARE STANDARD

- Injection Cylinder Retracts for Purging
- All Valving is Panel Mounted
- Complete with 3 Die Height Spacer Rings
- Has 2000 psi Pressure System
- Incorporates SPI Standard Ejection
- Designed to Reduce Overall Height

In numerous preliminary comparative tests on production molds, the L-225-6/9 oz. Lester has shown spectacular qualities of versatility and capacity. It is bound to become a new standard for specifications in its class.

LESTER-PHOENIX, INC.

2621-E CHURCH AVENUE • CLEVELAND 13, OHIO

Agents in principal cities throughout the world

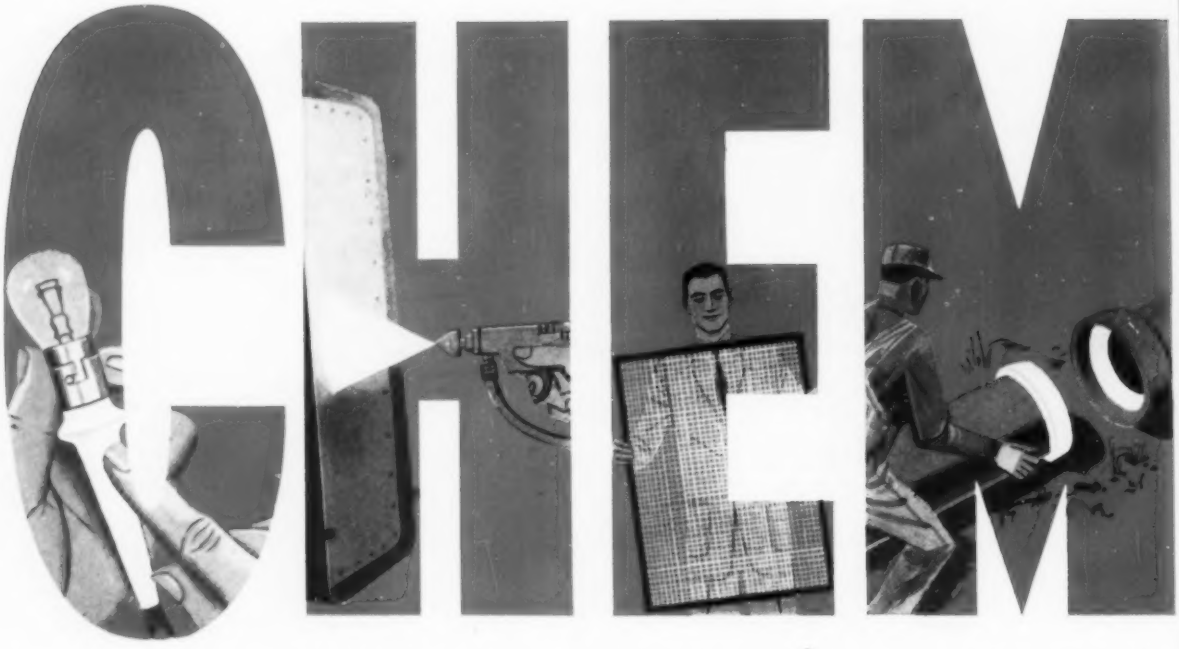
To prevent moisture and dust from entering automobile light sockets, a **chem-o-sol** was specially formulated for an economical high-speed dipping process (no costly molds required). It provides a tough, flexible coating. *(Watts Electric & Mfg. Co.)*

To resist corrosion, drums, tanks, and other large irregularly-shaped objects are sprayed with a structurally strong **chem-o-sol**. Cost savings of up to 35% result, and films of from 5 to 100 mils are possible.

To provide an essential coating for glass yarn used in strong, weather-resistant screening, a **chem-o-sol** with the correct flow properties was produced for economical application by high-speed die-wiping. *(Owens-Corning Fiberglas Corp.)*

To produce a tight seal that is permanently flexible and durable, a specially formulated **chem-o-sol** was tailored for clay pipe joints. A "flowed-in" gasket, it's applied by an in-plant molding process.

What they're doing with



may suggest an easier way to

ECONOMICAL TO APPLY
chem-o-sol ALSO HELPS CUT PRODUCTION COSTS

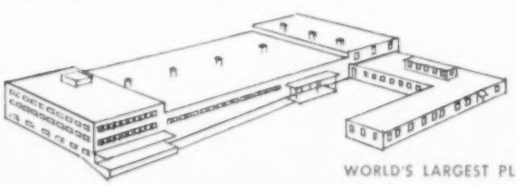
These are just a few of the applications already developed for Chem-o-sol. So versatile is this polyvinyl dispersion . . . so advanced the research, so vast the formulating experience and production capacity of Chemical Products Corporation that Chem-o-sol's product improvement possibilities are virtually *unlimited*.

For Chem-o-sol is more than a coating or molding *compound*. It is a new production tool! Formulated as a liquid without volatile components, it is converted to a strong, resilient solid simply by heating to about 350°F., *without pressure*.

Since each Chem-o-sol formulation is "tailor-made" to best suit the specific requirements of the end use, the formulator's touch is indispensable for translating ideas into reality.

To its practical experience, unsurpassed in point of time or scope, Chemical Products Corporation adds the world's largest and most modern facilities for the development and production of polyvinyl dispersions, including a completely equipped research laboratory to serve you.

IS THERE AN IDEA HERE for improving your own product? Then tell us about the proposed end use of Chem-o-sol.



WORLD'S LARGEST PLANT OF ITS KIND

Chemical Products
CORPORATION
East Providence, R. I.

Member Vinyl Dispersion Division of the S.P.I.

To impart a **slip-proof,** safety grip and increase wearability of cotton work gloves, palms and fingers are strategically dotted with **chem-o-sol** specially formulated to permit printing on fabrics at high speeds. *(Wells Lamont Corp.)*

To deaden noise, protect dishes from chipping, and resist grease and detergents, the familiar drainer is dipped in a special **chem-o-sol.** Wire constructions and metal and glass objects are coated easily and economically because only one dipping operation is necessary. Thickness to 60 mils is possible, in wide range of finishes.

To seal the new dry type automotive air cleaner into the car silencer and act as a structural member of the pleated paper element, a **chem-o-sol** was compounded for high-speed molding. Pre-cut gaskets and metal stampings were eliminated. *(From Corporation.)*

To improve heat resistance and physical and electrical properties of coatings for flexible sleeving (spaghetti tubing) used in electrical components, a **chem-o-sol** was tailor-made for heat resistance of more than 2000 hours at 225° F.

o improve your product

TECHNICAL FACTS ABOUT chem-o-sols

Chem-o-sols possess all the outstanding physical and chemical properties associated with polyvinyl chloride resins. Listed below are some of the properties available in almost any combination.

COLOR CHOICE — unlimited

TENSILE STRENGTH — as required from 1000 psi. to 2700 psi.

PERCENT ELONGATION — 350 to 600

HARDNESS (shore A2) — as required from 10 to 100
(shore D) — up to 65

FLEXIBILITY — to temperatures as low as —65°F

CHEMICAL RESISTANCE — outstanding to most acids, alkalies, detergents, oils and solvents

HEAT RESISTANCE — available to 225°F for as long as 2000 hours and to 450°F for over two hours

DIELECTRIC STRENGTH — minimum of 400 volts per mil when fused in sections 3 mils thick and over

SOLIDS CONTENT — 100%. Chem-o-sols can be molded in very thick sections

VISCOSITY — as required for dipping, die wiping, molding, casting, spraying, or spreader coating

CHEMICAL PRODUCTS CORPORATION
Dept. P-12, King Philip Road
East Providence 14, R. I.

Please send me a free copy of your **chem-o-sol** Brochure.

Name .....

Title .....

Company .....

Address .....

City ..... Zone ..... State .....

Proposed end use .....

.....

Application method .....

.....

Going Plastisols One Better... **chem·o·sol®**

THERMAFLOW® 105

HERE'S a high-strength reinforced molding compound that gives you a new slant on products you now make of die-cast metal, other plastics or by complicated sheet metal assemblies. Now Thermaflow 105 offers you flexural and impact strength ample for most uses, along with improved surface and excellent corrosion resistance . . . at a 20% saving over previously available compounds.

It's an "idea material" that pays off in improved quality and economy . . . in housings for appliances, television sets, radios, air conditioners, instruments . . . tanks, tubs, buckets, panels. You name it . . . we'll help you do it.

DESIGN DATA ON THERMAFLOW 105

	ASTM Bar	⅛" Random Cut Specimen
Impact strength ft.-lb./in. (Izod, notch)	12.0	4.5
Flexural strength	20,000	16,000
Heat distortion	>450°F	>450°F

Our new Technical Bulletin on T-105 gives the complete low-down on this remarkable compound. Write for your copy now.

ATLAC
THERMAFLOW

ATLAS

ATLAS POWDER COMPANY
Chemicals Division
Wilmington 99, Delaware

dimethyl phthalate
diethyl phthalate
di-(methoxyethyl) phthalate
di-isobutyl phthalate
dibutyl phthalate
di-isooctyl phthalate (DIOP)
dioctyl phthalate (DOP)

Eastman PLASTICIZERS

dioctyl adipate (DOA)
dioctyl azelate (DOZ)
plasticizer 84
—an octyl butyl phthalate
polymeric plasticizer NP-10
triacetin
tributyrin

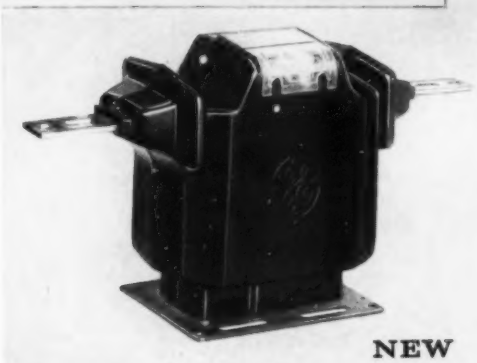
For highest quality finished products, rely on Eastman plasticizers—made under the most exacting and rigid specifications in the industry. Samples and technical assistance furnished upon request. Also write for our booklet describing Eastman plasticizers and their uses.

Eastman
CHEMICAL PRODUCTS, INC.
KINGSPORT, TENNESSEE
subsidiary of EASTMAN KODAK COMPANY

SALES OFFICES: Eastman Chemical Products, Inc., Kingsport, Tennessee; New York City; Framingham, Mass.; Cincinnati; Cleveland; Chicago; Houston; St. Louis. **West Coast: Wilson Meyer Co.,** San Francisco; Los Angeles; Portland; Salt Lake City; Seattle.

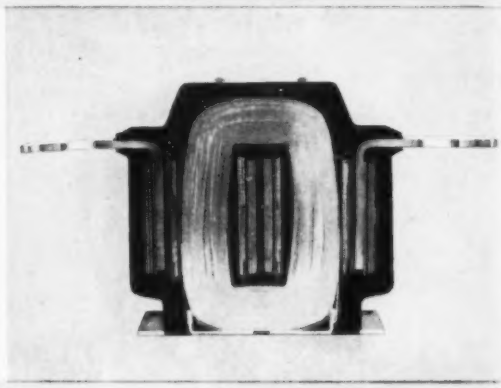
At Canadian General Electric Company, Limited:

Previous, asphalt-impregnated transformers, made by Canadian General Electric, Limited. Insulation strength was limited.



Streamlined transformers, molded with Epon resins, have superior insulation, dielectric strength; accuracy, performance are greatly improved.

Following curing period, the mold is quickly unbolted and the Epon resin-potted transformer removed.



Cutaway view of new instrument transformer clearly shows the complete penetration of Epon resins.

Epon® Resins improve performance, streamline appearance of instrument transformers

When Canadian General Electric Company, Limited, Toronto, Canada, decided to produce a new line of instrument transformers, they were faced with several critical problems: how to ensure performance, reliability, and appearance . . . all on a mass-production basis.

They solved all their problems with Epon resins.

Result: these handsome new transformers, completely impregnated with Epon resins, have high insulation and dielectric strength, good impact resistance, excellent heat dissipation, and increased ability to withstand creepage. Cracking and oxidation are virtually eliminated.

If potting, laminating, sealing or encapsulation play an important role in your operations, be sure to investigate Epon resins. They may be able to solve a production problem for you. For assistance and technical information, write to your nearest Shell Chemical office listed below.

SHELL CHEMICAL CORPORATION
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SHELL

The Plastiscope*

December 1958

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Sales of polyester resins. Several items in this column this month indicate that polyester resins are enjoying a real boom. Every month in 1958 except March has shown an increase over the same month in 1957; and a 10 million lb. month in May was the greatest in history. No other plastic, with the exception of polyethylene, can show an increase in every month of the year in 1958 over 1957. The total for all polyesters sold in 1958 should be around 125 million lb. in 1958 compared with 86 million in 1957, an increase of about 45 percent.

The Tariff Commission record indicates that only 11 million lb. or so of the 1958 total is for polyesters used for other than reinforcing resins. This would include casting resins, resins for buttons, compression molding resins, and the adipic-acid-type resin used in polyurethanes. Many analysts believe this 11 million is too small a percentage of the whole, but there is no way of checking its accuracy. The Tariff Commission can only report figures as they are sent in to them by producers of the resin, some of which may report their total output as being used as reinforcing resins even though parts of it may find other applications.

In any case, everyone recognizes that reinforced plastics are now growing nicely. Ten years ago sales were only a few million lb. a year, even though polyesters had come out of World War II boomed as the most sensational plastic discovery of the war era. Their use had dwindled to a few prototypes and a few low-volume applications. Heads rolled and pocketbooks "busted" during the next few years because markets were far below expected volume. But enthusiasm never died—it was often said there was more talk than resin. Problems of cost, low profit margins, shrinkage, hand labor, handling, have had to be overcome. And now it's a 100 million lb. plastic—not as big as the major thermoplastics, but still a good, sizable volume.

Reinforced plastic truck cab. A daring investment in the potential value of a molded polyester-fibrous glass truck cab is represented in the widely publicized new White "5000" highway tractor. Weight-saving, long life, and easy repair are the chief factors expected to outweigh the high cost of development and the matched-mold operation. There are 30 separate molded pieces in the job, which are assembled and bonded on special jigs.

The cab is produced by Molded Fiber Glass Body Co., Ashtabula, Ohio. It weighs about 300 lb. (200 lb. resin and 100 lb. glass) compared with about 550 for a metal cab body. It is only 50 in. from bumper to back of the cab—conventional cabs are about 96 inches. Interesting construction features are a molded-in air duct in the back wall which brings air from the top of the cab to the engine compartment which also acts as a reinforcement to the body, and multiple ribbing in the roof panel for strength. White officials make

*Reg. U.S. Pat. Off.

CYASORB*...

the biggest brand name in product protection under the destructive sun!

CYASORB is Cyanamid's trademark for their UV Light Absorbers . . . products developed to provide the ultimate in protection against damaging ultraviolet . . . products with the potential of opening up big new product applications *for you* in the rapidly expanding outdoor market. Easily and economically incorporated into your formulations, CYASORB Light Absorbers will actively prevent UV-caused degradation that limits outdoor uses.

IN PVC, for example, CYASORB UV 24 Light Absorber prevents browning, spotting and embrittlement caused by sunlight. During exposure tests in Florida and Arizona, PVC samples treated with 0.2 phr CYASORB UV 24 showed an average life span five times greater than untreated control samples.

IN POLYESTERS, clear unprotected ⅛ inch castings showed pronounced yellowing when exposed to a GE S-1 sun lamp for two hundred hours. Identical samples, with 0.25% CYASORB UV 9 added, showed less yellowing *even when exposure was increased fivefold.*

IN POLYSTYRENE, samples containing 0.2% CYASORB UV 9 showed 50% less yellowing than untreated controls after 400 hours in Fade-Ometer.

IN SURFACE COATINGS and thin films, CYASORB UV 24 provides outstanding protection to the substrate and to the film itself. An .0008 inch plastic coating containing .004 ounces of CYASORB UV 24 per square foot screened out 91% of the ultraviolet that passed through a similar, but unprotected, system. (Both films were coated on glass.)

These few examples show the effectiveness of CYASORB Light Absorbers even in fractional percentages. If you have a problem involving ultraviolet degradation, Cyanamid's unequaled experience in the use of UV light absorbers is readily at your disposal. Just fill out and mail the coupon below.

*Trademark

CYANAMID

AMERICAN CYANAMID COMPANY
Intermediates Department
Bound Brook, New Jersey

Gentlemen:

I am interested in the product protection offered by CYASORB Light Absorbers.

PLEASE SEND: ☐ Literature on CYASORB UV 9
☐ Literature on CYASORB UV 24

NAME_____

COMPANY_____

ADDRESS_____

OUR PRODUCT INTEREST IS_____

(MP-12)

The Plastiscope

(*Continued from page 37*)

a particular point of the ease of repair. A $1.50 repair kit containing resin, activator, resin impregnated glass cloth, and simple tools are all that is needed. Furthermore, it is easy to replace any one of the 30 molded parts.

White gives the following reasons for using reinforced plastics: fewer parts required in fabricating because components can be molded in complex shapes; warmer in winter and cooler in summer because of low thermal conductivity; less noise because reinforced polyester does not reverberate like metal; impervious to rust, salt, or road chemicals; low-cost repair.

Resins used are Selectron, Plaskon, and also a formulation made by the molder. Isophthalic and fumaric are used in this general purpose polyester to obtain better impact and better strength at higher temperatures.

Fumaric acid supply. In view of the foregoing, it is interesting to note that a new supplier of fumaric acid is Pittsburgh Coke & Chemical Co., which also produce maleic and phthalic anhydride. All three materials are widely used in production of polyester resins for reinforced plastics. Present production of fumaric is estimated at 10 million lb. by Pittsburgh Coke.

Fumaric is frequently used with maleic in polyester formulations and has been used at times as a complete replacement. Some processors assert that it may give faster curing, raise the softening point, and is more light stable. Esters of fumaric may also be used in vinyl copolymers.

Methacrylate "Sirup" moves into reinforced field. Readers of this column have been duly notified at various times over the past two years that a new resin for reinforced plastics was coming. The material is Du Pont's "Lucite Sirup," a partially polymerized mixture of methyl methacrylate.

First announcement that fibrous glass-reinforced panels made with this material are available has came from Naugatuck Chemical with the statement that that company will market such panels as produced by the Russell Reinforced Plastics Corp., Lindenhurst, N. Y. Called Tropiglas, the panels will be in sheet sizes up to 3½ by 8½ ft. and in thicknesses from 0.060 to 0.100 inch. Applications include sun deck roofing, partitions, and glazing uses.

Methacrylate has long been known to have superior weathering properties and consequently will be welcomed by the reinforced plastics industry for use in outdoor panels. Under certain circumstances the "Sirup" is claimed to have better impact and less creep than general-purpose polyester but no superiority is claimed over the special, resilient polyester mixes for these properties. The "Sirup" is supposedly less subject to "strain." The same catalysts are used for activation as with polyester resins. The cost is around 39½¢/lb., which is several cents higher than the special light-stable polyesters.

When compared with cast methacrylate, the new "Sirup" used with fibrous glass is said to give a 50% cost saving in light diffusers; it will withstand higher heat and has less creep than polystyrene or methacrylate; it can be made into a larger panel without need of support.

Bakelite changes name and establishes new selling-marketing alignment. On November 15, one of the oldest names in plastics, "Bakelite," passed from the scene as the name of a company or division of a corporation. Henceforth it will be known as the Union Carbide Plastics Co. The change was made to

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Chemical Division GENERAL
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VYGEN 85 0.80 IV. Recommended for calendering—particularly for rigids and semi-rigids—and injection molding.

VYGEN 105 0.93 IV. Adapted for calendering high gravity, light embossed sheeting. Used for molding and extrusions requiring a high gloss.

VYGEN 110 1.03 IV. General purpose resin for easy processing of calendered film, sheeting and coated fabrics. Also used for extrusion and molding.

VYGEN 120 1.18 IV. Dry blend extrusion resin. Approved by U. L. for electrical applications.

VYGEN 161 1.03 IV. Low bulk density—high plasticizer take-up resin. Gives a dry premix in unheated blenders.

The Plastiscope

(*Continued from page* 39)

"cement" corporate identity with its parent, Union Carbide Corp., and is described as another step in the corporation's program to identify its broad range of products under one name. The Plastics Co. will continue to use the name "Bakelite" as a trademark for many of its products.

At the same time J. D. Benedito, VP Sales, announced a new alignment of the company's sales staff with the avowed purpose of giving its customers more concentrated personal service. The key to this close contact is a system whereby six regional managers have been given broad decision-making powers to deal individually with their local customers. Details of this new company set-up will be found on p. 220.

Dow expands polyethylene capacity. The announcement that Dow will double its present high-pressure-produced polyethylene capacity at Freeport, Texas, and then expand still further in 1959, has been expected for some time, but the announcement emphasizes the unbelievable growth of the market for this particular type of polyethylene.

Dow began production in 1955 with three resins—the company now sells 30 different compounds. The firm has also expanded its compounding facilities, which anticipates the introduction of wire and cable formulations in 1959. The above announcement has no relation to Dow's linear polyethylene plant now being constructed at Bay City, Michigan.

The Dow increment means that all high-pressure producers will have a combined capacity of over one billion lb. by mid-1960. Low-pressure producers already have a capacity of over 300 million pounds. Today's actual capacity to produce high-pressure material is not much above consumption, total of which should be between 750 and 800 million in 1958, but as noted above, capacity is still growing. A guess, subject to revision when more information is available, would place consumption of low-pressure polyethylene at around 40 to 60 million lb. in 1958.

Film from high-density polyethylene. The article concerning polyethylene film starting on p. 98 of this issue gives considerable space to discussing the differences of opinion concerning extrusion of high-density film. Since that article was written, Koppers Co. has given a clear-cut answer to a choice between the three types of extrusion when using its Super Dylan Type 6060F high-density resin for producing films for specific purposes.

The company suggests a water-quench method where clarity and gloss are of prime importance for overwraps and where ease of opening is a necessity; chilled-roll casting where a more balanced film, strengthwise, is desired; tubular or blown for packaging frozen or other foods designed to be cooked or boiled in the bag.

Allied's polyethylene for large diameter pipe. Large-diameter polyethylene pipe that will enter a field heretofore largely held by metal, ceramic, and fiber pipes is now being produced from Allied's A-C Polyethylene Pipe Compound. A special extrusion technique utilizing standard machinery has been developed to handle this extremely high-molecular-weight and high-melt-viscosity mate-

PACKAGING DESIGN IN PLASTICS

THE RONSON SHAVER CASE

A durable case with molded-in beauty: This handsome gray and gold shaver case was designed to (1) provide the Ronson C.F.L. Electric Shaver with day-in, day-out packaging protection, and (2) give Ronson a package with powerful masculine sales appeal. How was it accomplished? By using DYLENE polystyrene, a lightweight material that molds in a vast range of stimulating colors — colors that remain constant from package to package.

DYLENE also has remarkable dimensional stability. For instance, notice the shield that is molded directly into the top of the case. It's covered by a clear crystal piece that is easily removed so that the retailer can personalize the case with the customer's initials. And, here's an important part-saving feature. The bezel, usually a separate metal insert in this type of container, is now a gold-coated molded ridge around the inside of the base.

For more information on design-adaptable DYLENE polystyrene, DYLITE expandable polystyrene, SUPER DYLAN polyethylene and DYLAN polyethylene, wire or write Koppers Company, Inc., Plastics Division, Dept. MP-128, Pittsburgh 19, Pa.

TWX Call Number PG533

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Molder: Auburn Plastics, Inc., Auburn, New York.

Offices in Principal Cities • In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario

KOPPERS
KOPPERS PLASTICS

The Plastiscope

(*Continued from page* 41)

rial. The high strength makes possible the extrusion of large diameter pipe without unusual increases in wall thickness. Company test data shows a life expectancy of 50 years, no cracking, slitting, or pin-holing. The large-diameter pipe is available through Carlon Products Corp. See p. 224 for details.

Another caprolactam plant. Du Pont has announced plans to build a 50 million-lb.-a-year plant to manufacture caprolactam, an intermediate chemical for type 6 nylon fiber and plastics. The company claims that development of a new process for producing the intermediate from low-cost petroleum derivatives will result in prices considerably below present levels. Caprolactam is widely used in Europe to make nylon-6, which competes with the 6/6 type for fabrics and plastics. Du Pont says its caprolactam will be produced for sale outside the company. Allied will add new facilities to its Hopewell, Va., caprolactam plant, giving that company a total capacity in excess of 60 million pounds.

Exactly what this means to plastics is not clear. Caprolactam is supposedly intended primarily for fabric but Allied, Spencer, and Foster Grant are now all producing nylon-6 plastic from caprolactam. Du Pont has always had a caprolactam polymer as one of its Zytel formulations but has never pushed it and, of course, will soon have Delrin that is expected to compete with nylon for many applications. The mention of a "considerably lower cost" for caprolactam monomer is intriguing because of the implication that material for production of nylon-6 may become "considerably" cheaper hereafter.

New polymeric plasticizer. Monsanto Chemical Co. has announced a new polymeric plasticizer which is reported to give lower odor and color, faster processing speed, better efficiency, greater resistance to extraction and migration, and higher retention of physical properties after heat aging than previous polymerics in the low-cost price range. It is said to improve low temperature flexibility with no loss of tensile strength and to improve fusion properties by 20 percent. Called Santicizer 409, it is a true polymeric (from a dibasic acid and a glycol) and should not be confused with epoxy type plasticizers.

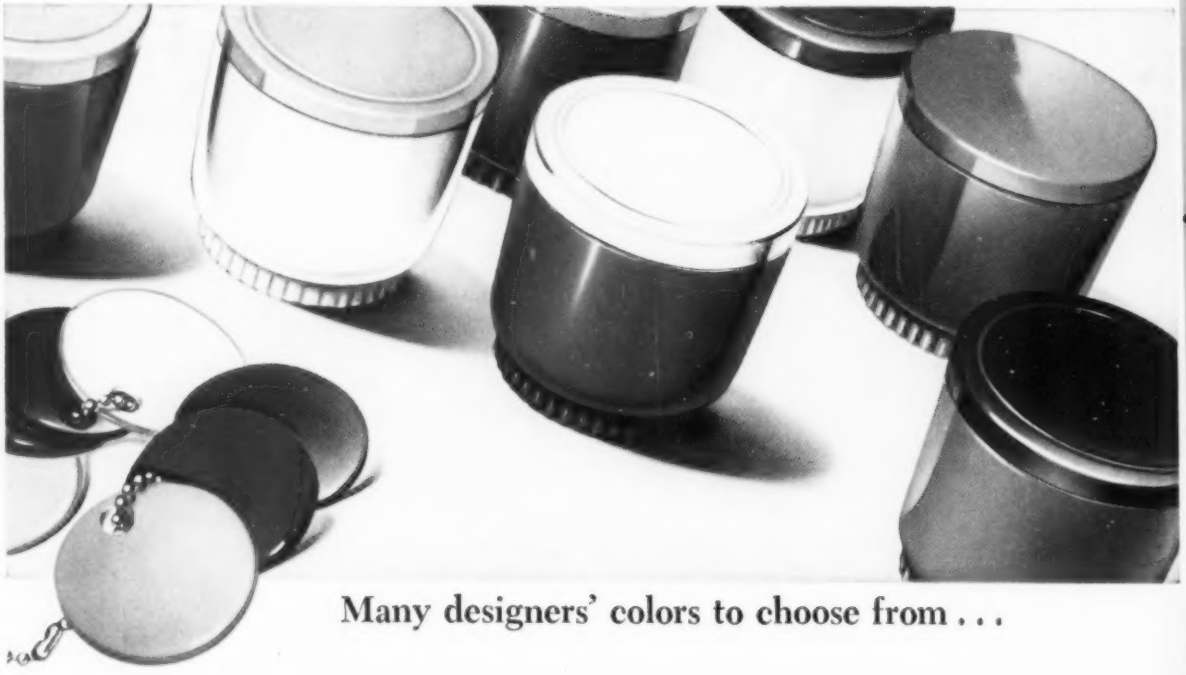
Polyethylene molding material price drop. Eastman Chemical Products has reduced the price of one type of polyethylene molding material from 35 to 33 cents. It is a 20 melt index in a density of 0.915 and is used primarily in housewares because of fast flow and good surface finish. It is the same resin that has been up and down in price before and this reduction may be a move to counter the reported sales of similar material at reduced prices under the guise of off-grade. Other molding grades than this particular formula remain at 35 cents. At one time resins of this type with a high MI were the chief material for housewares items but many molders have now shifted to stiffer formulations.

Eastman also introduced a new film grade resin with superior impact strength and greater resistance to blocking and reduced to 37¢ the price of ultraviolet-inhibited natural, which now puts it in the same price range as those resins containing antioxidants and antistatics.

For additional and more detailed news see Section 2, starting on p. 220

Convenient screw closure . . .
seals tightly, opens easily

Tip-proof design . . .
jars stack quickly, securely



Many designers' colors to choose from . . .

New Plastic Jar by Owens-Illinois
. . . has all the makings of a top-priced package!

HERE in O-I's new 4½-ounce Plastic Jar you have all the advantages your salespackage needs—color and eye-appeal . . . shelf advantages retailers like . . . user conveniences customers look for. It's a package you'd expect would be priced far higher!

Smartly designed—Plastic Jars stack easily, securely. Their screw closures seal tightly, open easily. And as for color or an eye-catching color combination—you can almost name it! For, in addition to clear plastic, jars are available in a wide variety of opaque and transparent colors. (Also available with domed-top cap.)

* * *

Find out more about O-I's new Plastic Jar. Your Owens-Illinois representative will be glad to show you samples. Telephone him, today!

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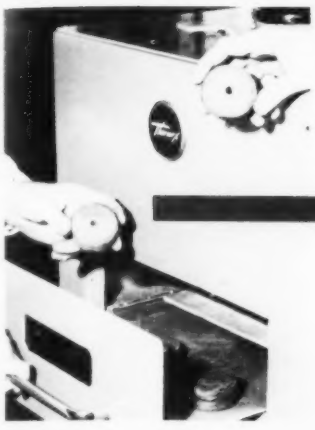
the new



Thermex®

PLASTICS PREHEATING UNIT

MODEL 3 RC

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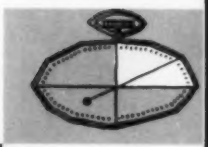
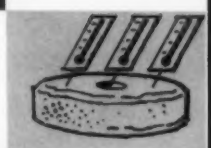
NEW PERFORMANCE

Preheat time is cut in half on small loads. This is particularly true of hard-to-heat materials such as melamine and mica filled phenolics.



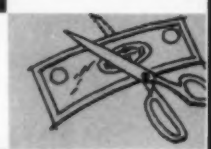
NEW EXCLUSIVE FEATURES

A newly designed electronic control automatically adjusts for variations in moisture content, density, and room temperature to deliver uniformly heated preforms.



LOWER INITIAL COST

The all new design gives greater flexibility at lower initial cost.



EASY OPERATION

The sliding drawer is designed for easy, safe loading. The high frequency power comes on only when the drawer is closed. When the preforms reach the desired temperature, power is automatically cut off.

SEE SPECIFICATIONS

specifications

THERMEX MODEL 3RC 3 KILOWATT

HEATING CAPACITY: 2¼ lbs. to 240°F. in one minute; 3 oz. in four seconds. Electrode 10" x 10" with height adjustable from 1" to 4". Fluorescent tube for tray light. Easy to use tray for preforms.

CONTROLS: Conveniently located on front panel. Controls include plate meter, load cycle adjustment, and main circuit breaker. Note: Grid controls not needed. Electrode adjustment is located on top of cabinet.

CONSTRUCTION: Attractively finished aluminum cabinet mounted on rubber tired casters—two swivel and two fixed. Handles on cabinet for ease in moving.

FREQUENCY: 100 megacycles, nominal.

TUBES: One (1) 5762/7C24 Oscillator
Four (4) 872A Rectifiers

POWER DATA: 230 volt, 60 cycle, single phase. (For 460 volt operation a stepdown transformer can be used.) Power input—6.3 k.v.a. Power output—3 k.w.

DIMENSIONS AND WEIGHT: Height—50½"
Width—21"
Depth—24"
Weight—275 lbs., net.

INSTALLATION: Installation by factory engineer.

GUARANTEE: Guaranteed against defects in workmanship and materials for one year with exception of vacuum tubes which are guaranteed for one thousand hours filament operation or one year, whichever period expires first.

CERTIFICATION: Certified in accordance with requirements of the Federal Communications Commission.

GIRDLER PROCESS EQUIPMENT DIVISION • CHEMETRON CORPORATION

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The SPECIAL grades of Erinoid polystyrene

The range of Erinoid polystyrene moulding powders provides materials which meet the exacting requirements of today's most varied applications and manipulation techniques. In this range there is a group of *special* grades giving three outstanding qualities—heat resistance, increased strength (with transparency) and light resistance.

HEAT RESISTANCE

Four grades are available. Each has a softening point of 100°-103°C. and a permanent heat distortion resistance of 85°C.

HS This is the 'general purpose' heat resistant grade.

2CL/HS A high molecular weight polystyrene with an overall 50% increase in strength. Available in all colours, including crystal clear.

CP.20/HS A high-impact polystyrene with exceptional elongation and flexural strength. Its outstanding feature is the very high gloss surface finish obtainable on mouldings.

ACN/HS Styrene acrylonitrile copolymer which has a strength figure 50-100% higher than general purpose polystyrene. It has good resistance to abrasion and crazing. ACN/HS has excellent electrical properties and metal inserts can be moulded in. It is resistant to attack by petrol, white spirit, fruit juices, acids, alkalies, fats, inks and disinfectants. Tea and coffee do not stain ACN/HS.

INCREASED STRENGTH

2CL 2CL/HS High molecular weight polystyrene, grade 2CL, gives 50% increase in strength—*at no extra cost*. This grade is ideal for mouldings which have to withstand flexing, vibration or shock. This increased toughness is achieved without impairing the crystal clarity of the material. It is also available in a heat resistant grade 2CL/HS—see above.

LIGHT RESISTANCE

Colour formulations 3L121 and 3L133 Ordinary grades of polystyrene, particularly in crystal and opal shades, are liable to yellow considerably after about eight months' use. To overcome this, four of the Erinoid grades have been light-stabilised. Erinoid light-stabilised grades resist yellowing for up to 3½ years. In addition to allowing maximum light transmission these grades effectively diffuse the light. The four Erinoid grades available in light-stabilised form are: KLP, 2CL, 2CL/HS and HS.

TYPICAL APPLICATIONS

Electrical coil formers.
Foil for capacitor insulation.

Electrical components.
High-quality monofilament.
Disposable packs, (e.g. for jam, allowing hot-filling).

Vacuum flask cups.
Electric razor housings.
Jelly trays.
Motor car & radio components.

Monofilament.
Oil filter bowls.
Household utensils.
Canteen-ware.
Motor car components.
Office machinery.
Vacuum cleaner components.

Bathroom and kitchen fittings.
Moulded packs.
Radio cabinets.
Monofilaments.

Lighting fittings, including extruded sections and moulded diffuser screens.

These special grades are all available as moulding powder, sheet and extruded sections.

Erinoid polystyrene is manufactured by

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Full information, samples, prices etc., on application to

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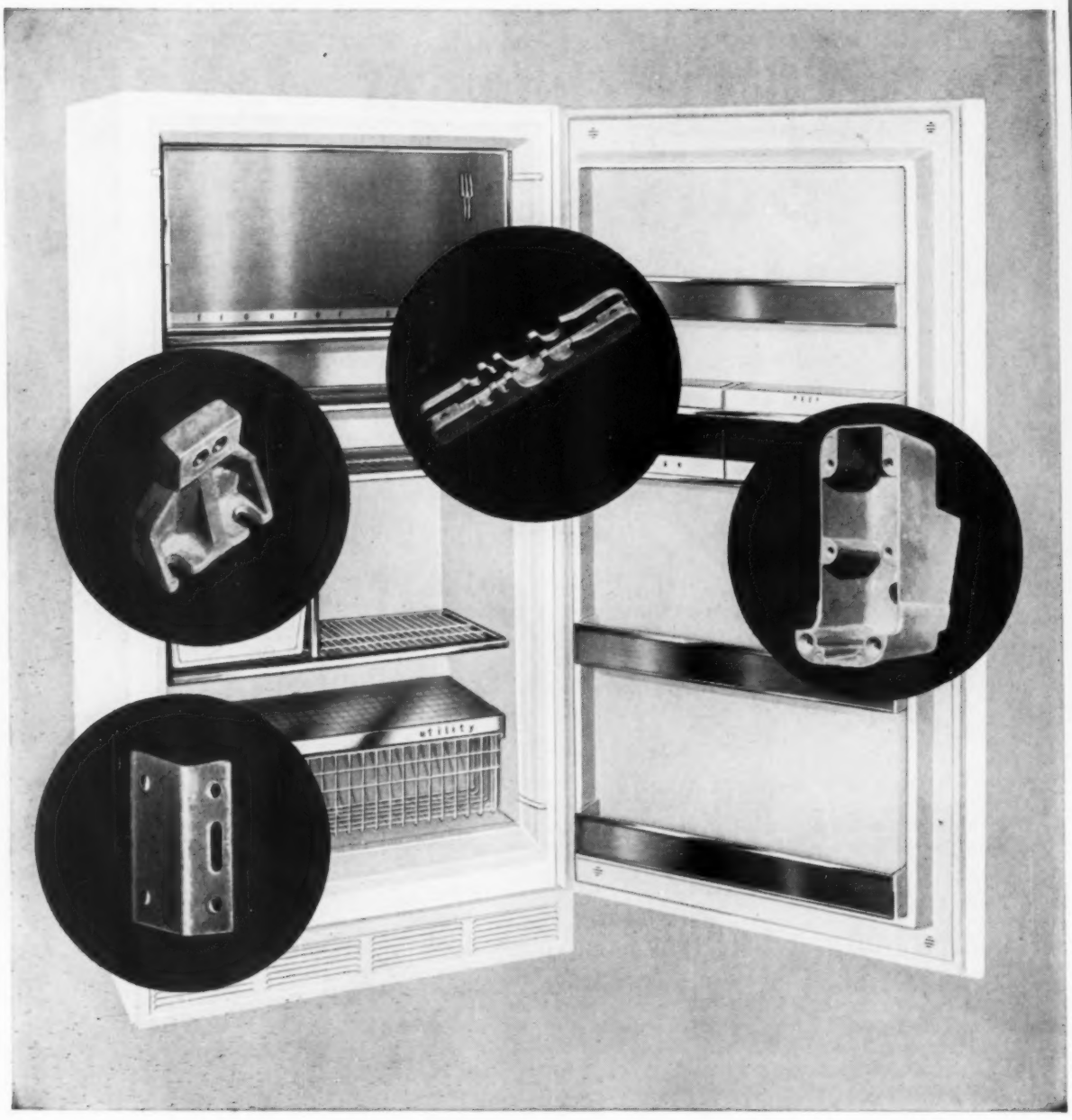


Kelvinator gets big benefits from premix moldings

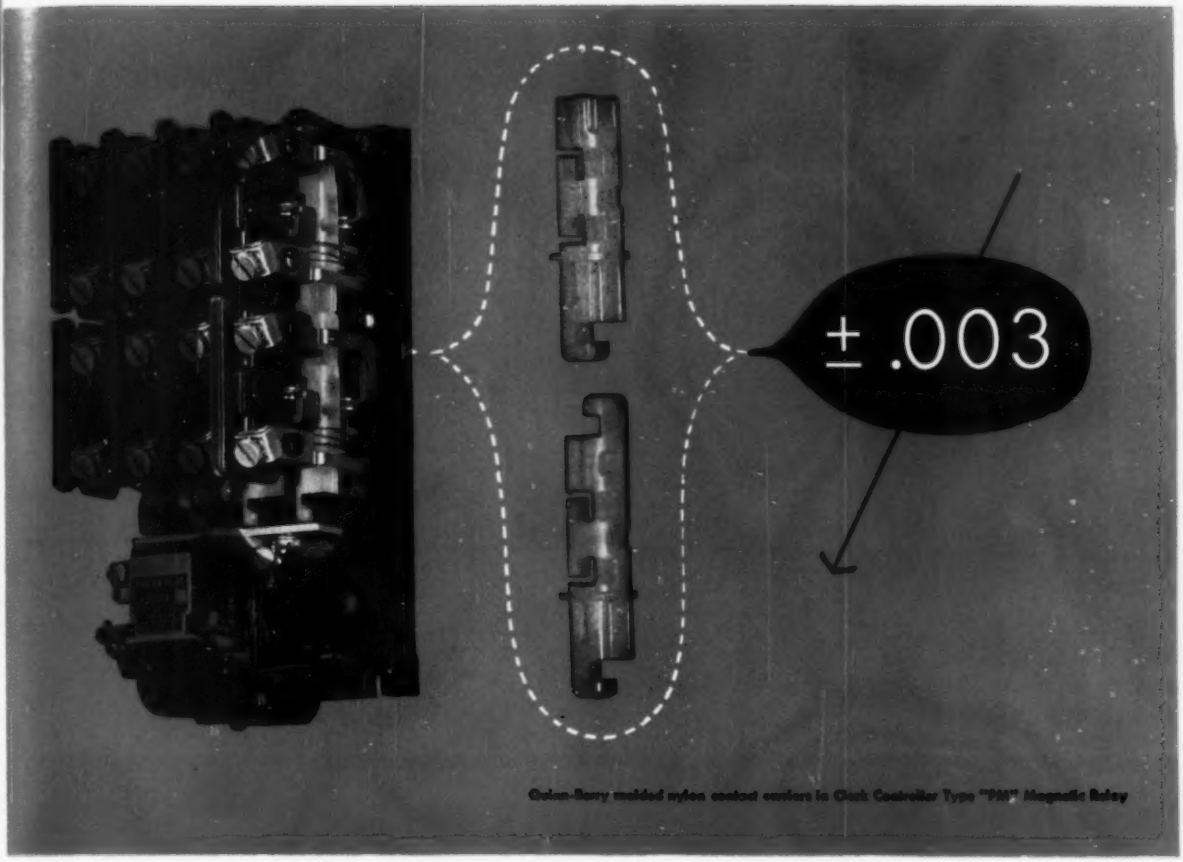
Premix moldings are making an important contribution to performance of Kelvinator refrigerators.

Strike mounting plates, tie-straps, tubing retainers and lock housings for the Kelvinator are all premix moldings. They've proved tough and resilient . . . excellent shock absorbers. And their thermal insulating properties contribute to the economical operation of the refrigerator.

When resins and reinforcing fibers are blended beforehand, moldings are stronger, wall thicknesses more uniform, weak spots are eliminated. Small and large, simple and complex, premix moldings are not only improving products but cutting costs for hundreds of manufacturers.

If your product calls for strong, rigid, reinforced plastics, look into premix moldings made with Dow vinyltoluene or Dow styrene. Get the names of molders and suppliers from your nearest Dow sales office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Plastics Sales Dept. 2207F-2.

YOU CAN DEPEND ON DOW



Quinn-Berry molded nylon contact carriers in Clark Controller Type "PM" Magnetic Relay

Impossible Tolerances In Molded Nylon?

.....not at *Quinn-Berry*

Extremely close tolerances, dimensional stability, high wear-resistance . . . these were the demanding specifications for the contact carriers shown above. Quinn-Berry's answer to the problem: careful choice of the right plastics material . . . precision mold design and manufacture . . . skilled pressroom craftsmanship. The result: components of consistent quality which contribute to the trouble-free performance of the Clark Type "PM" Magnetic Relay.

Step by step, under one responsibility and one control, every job is engineered from die design to finished product at Quinn-Berry where the "Unusual Is Routine" in molded thermoplastics. Consult with us in full confidence of the desired result.

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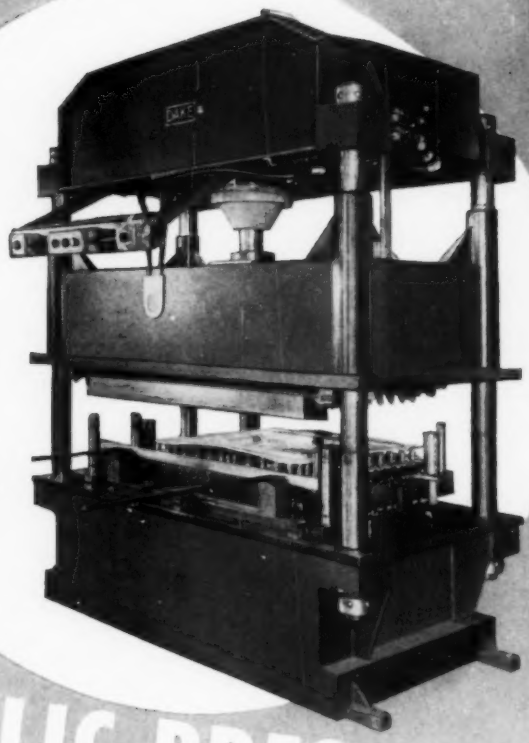
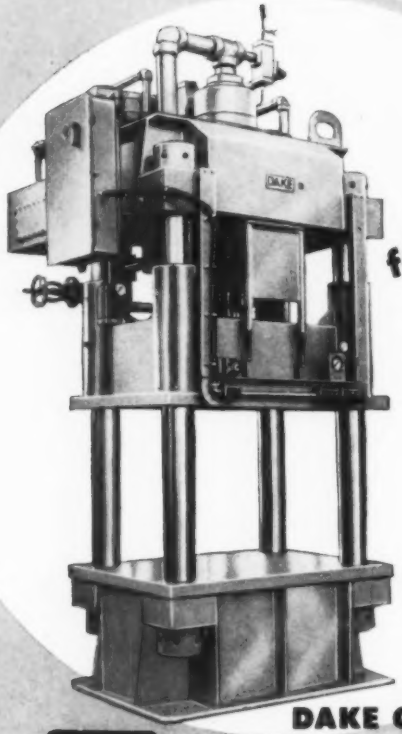
MOLDERS OF ALL TYPES OF THERMOPLASTICS

available in standard and custom engineered models



for trimming and piercing vacuum-formed plastics

DAKE HYDRAULIC PRESSES



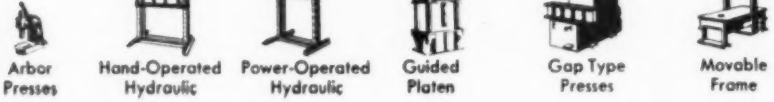
for molding reinforced plastics

Be a pacemaker in the fast-moving plastics industry with equipment designed to keep production geared to modern trends. Dake Hydraulic Presses speed output and reduce costs. They are job-engineered by men experienced in the plastics industry. These men are ready to help you meet special requirements as well as provide better equipment . . . both for compression molding of reinforced plastics as well as trimming and piercing vacuum-formed plastics. Standard models are electric-hydraulic in operation, with capacities ranging from 25 to 300 tons. They are adjustable for stroke, pressure, temperature and timing. Dual palm-operated controls are standard, providing safety in operation. Dake will gladly work with you in developing whatever special press equipment you need.

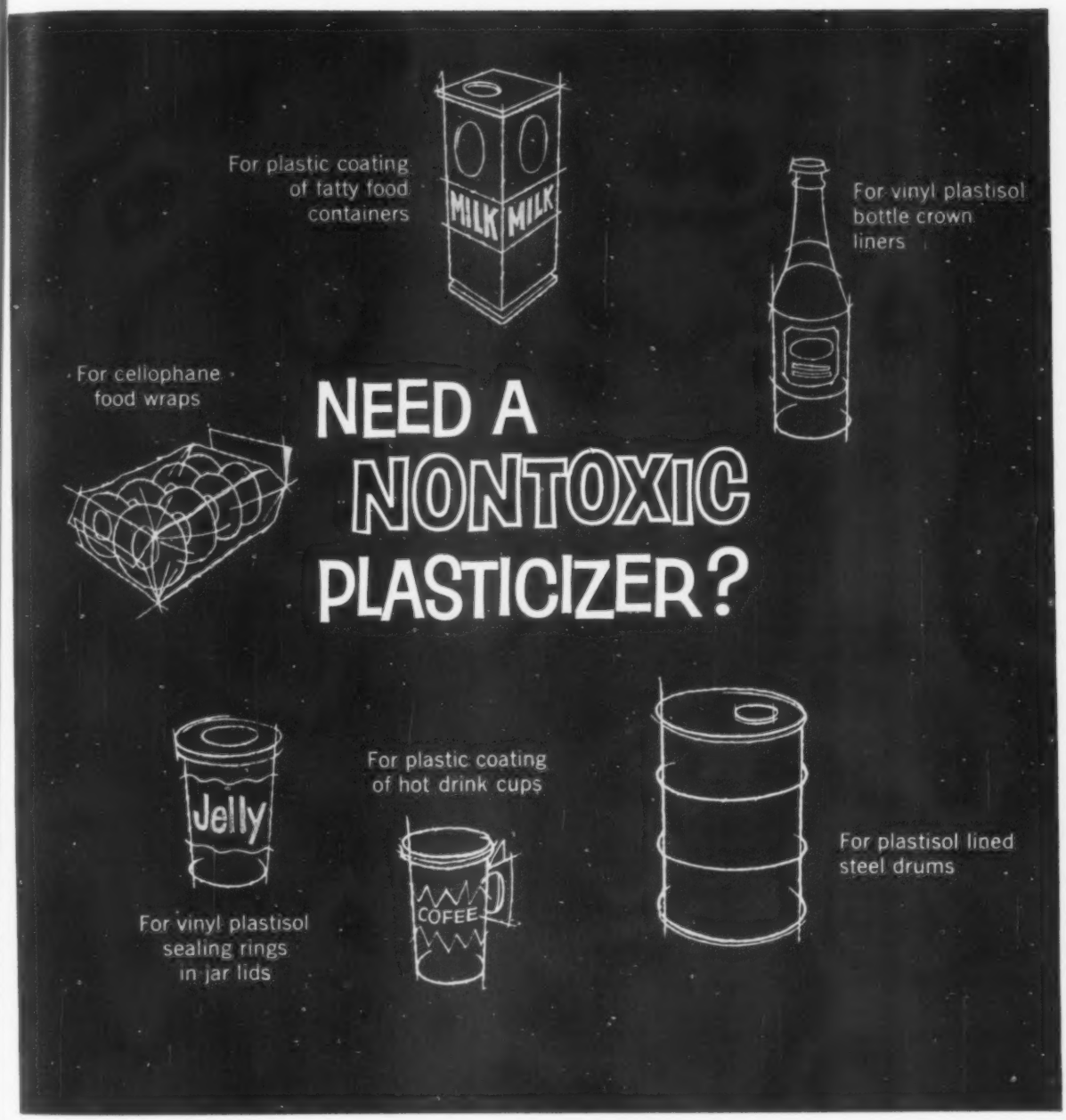
For descriptive literature on these presses, write for Bulletins 340 and 352.

DAKE CORPORATION 648 Robbins Road, Grand Haven, Michigan

DAKE PRESSES



Arbor Presses | Hand-Operated Hydraulic | Power-Operated Hydraulic | Guided Platen | Gap Type Presses | Movable Frame



The low cost of Pfizer CITROFLEXES® will surprise you!

For all these and many other plasticizer applications you should investigate the nontoxic, odorless Pfizer Citroflexes.

Citroflex A-2 (Acetyl Triethyl Citrate) for cellulosics is especially suited for use in plastic food wraps such as cellulose acetate packages for processed meats, doughnuts, etc.

Citroflex A-4 (Acetyl Tributyl Citrate) for polyvinyls is used in such vinyl products as food container coatings, bottle crown liners and for food-jar-cap sealing rings.

Both Citroflex A-2 and A-4 are nontoxic and odorless. They are accepted by the Food & Drug Administration for use in plastic packaging of both fatty and non-fatty foods.

Science for the World's Well-Being

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More Than 100 Years Of Know-How

of the Engineering Staff at Modern Plastic Machinery Corporation are represented in the new "CENTURY SERIES" of Extruders available in screw sizes from 1" to 8" diameter

BEFORE YOU BUY ANY EXTRUDER... *Compare* mpm

At modest cost you receive:

- Air-cooled cylinders.
- Xaloy 306 liners in all sizes—1" to 8".
- High speed, high horsepower, high pressure (10,000 psi working pressure).
- High-thrust bearing capacity.
- Long bearing life.
- True bearing ratings.
- Over-size herringbone gear transmissions in 2½"- 8" sizes.
- 16:1—20:1—24:1 Length/Diameter ratio cylinders (measured from front of feed opening). (Special lengths on request.)
- Vented cylinders, hoppers or screws.
- Interchangeable band heaters, cast-in heaters, induction heaters.
- Easily replaced cylinders.
- Complete packages fully wired for low cost installation.

A full line of valves, pressure gauges, dies and other accessories are available.

MPM AIR-COOLED PLASTIC EXTRUDER
Model No. EF-250-20

MPM Extruders are available in screw sizes of 1" — 1½-2" — 2½" — 3½" — 4½" — 6" — 8" with cylinders of 13.1 — 16:1 — 20:1 — 24:1 — LE/D Ratio — with or without vents

MPM Model No.	ESF-100-12 EF-100-12	EF-250-20	EF-350-20
Screw Diameter	1"	2½"	3½"
Le/D Ratio	12:1	20:1	20:1
Heating Load—Watts	1800	12,750	25,000
Heating Zones	2	4	4
Gear Ratio (Standard)	20:1	23.8:1	24.9:1
Transmission HP at 75 RPM	.45	28	37
Type Gears	Worm	Herringbone	Herringbone
Thrust Bearing Capacity Dynamic Load Rating	11,750#	215,000#	400,000#
B-10 Life at 75 rpm	4,000 hrs. at 5,000 psi 32,000 hrs. at 2,500 psi	27,000 hrs. at 10,000 psi 216,000 hrs. at 5,000 psi	25,200 hrs. at 10,000 psi 201,600 hrs. at 5,000 psi
Motor HP	.5	15 - 25	25 - 30
Screw Speed (Standard)	8-80 rpm	7-85 rpm	7-85 rpm
Output per hour	6-12 lbs.	85-135 lbs.	200-250 lbs.
Cooling System—Cylinder	None	Air	Air
Cooling System—Hopper	Water	Water	Water

Note: B-10 Life —
See Anti-Friction Bearing Mfg. Assoc. Stds. Specifications for other size Extruders on request.

100% COMPLETE PACKAGED UNITS WITH ALL ACCESSORIES ●

modern plastic machinery corp.

15 Union St., Lodi, N. J., U.S.A. • Cable Address: MODPLASEX

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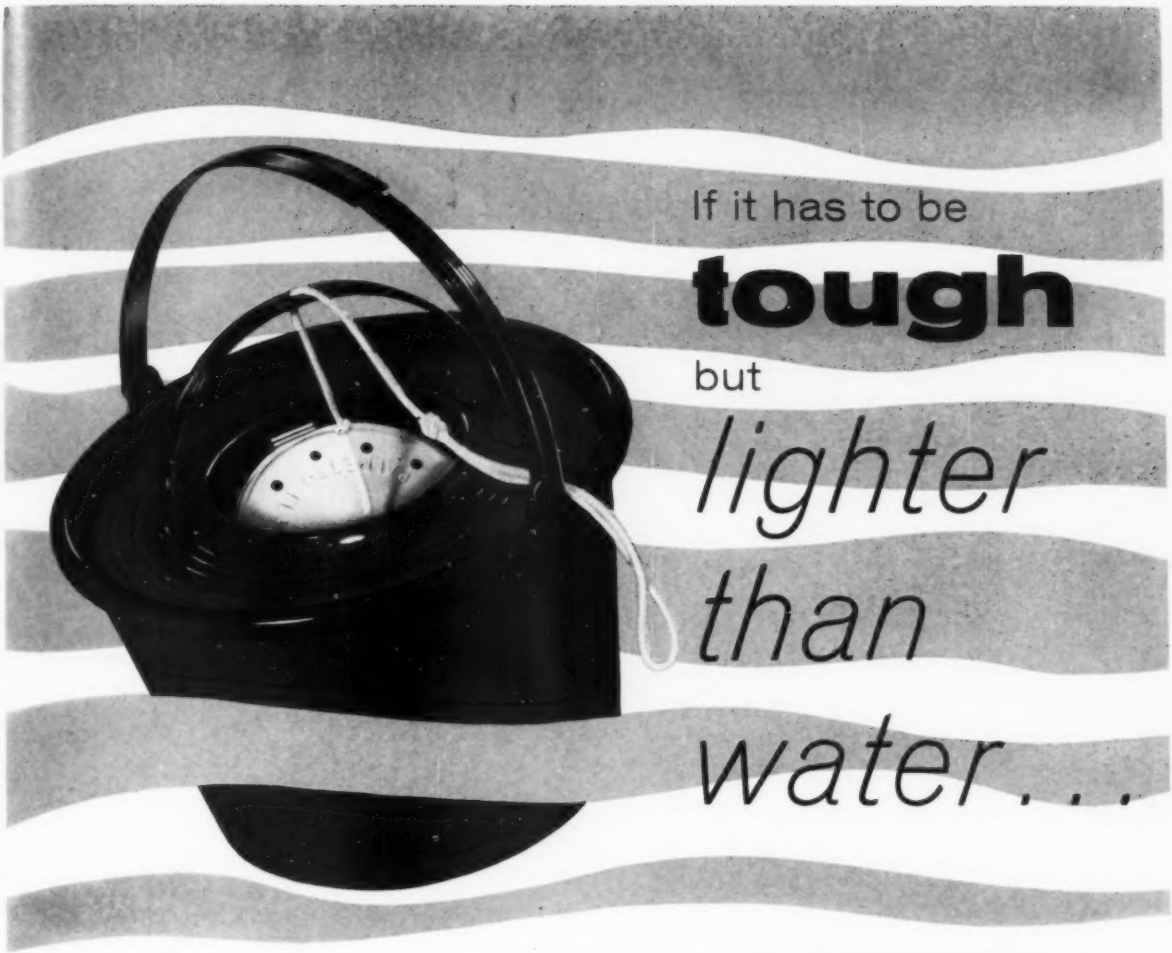

Betta Bait Bucket Made of GREX, by Florida Plastics, Palmetto, Florida

make it with **GREX*** HIGH DENSITY POLYETHYLENE

The problem was this: find the right material for a better bait bucket . . . something unique, appealing to the common sense of fishermen. It had to be tough, yet it had to float. It had to be colorful, corrosion-resistant, and easily cleaned. And it had to be practical to manufacture. After many experiments, with many materials, the answer was this: *it had to be* GREX.

GREX high density polyethylene has remarkable impact strength—takes any amount of knocking around without breaking. For all its strength, GREX is lightweight. It bobs to the surface if dropped overboard. Salt water won't harm it. The color *stays bright.*

Toughness, lightness, wonderful color. You can use these properties in your product. Remember, this versatile plastic can mean *better products for you.*

W.R. GRACE & CO.
POLYMER CHEMICALS DIVISION
225 ALLWOOD ROAD, CLIFTON, NEW JERSEY
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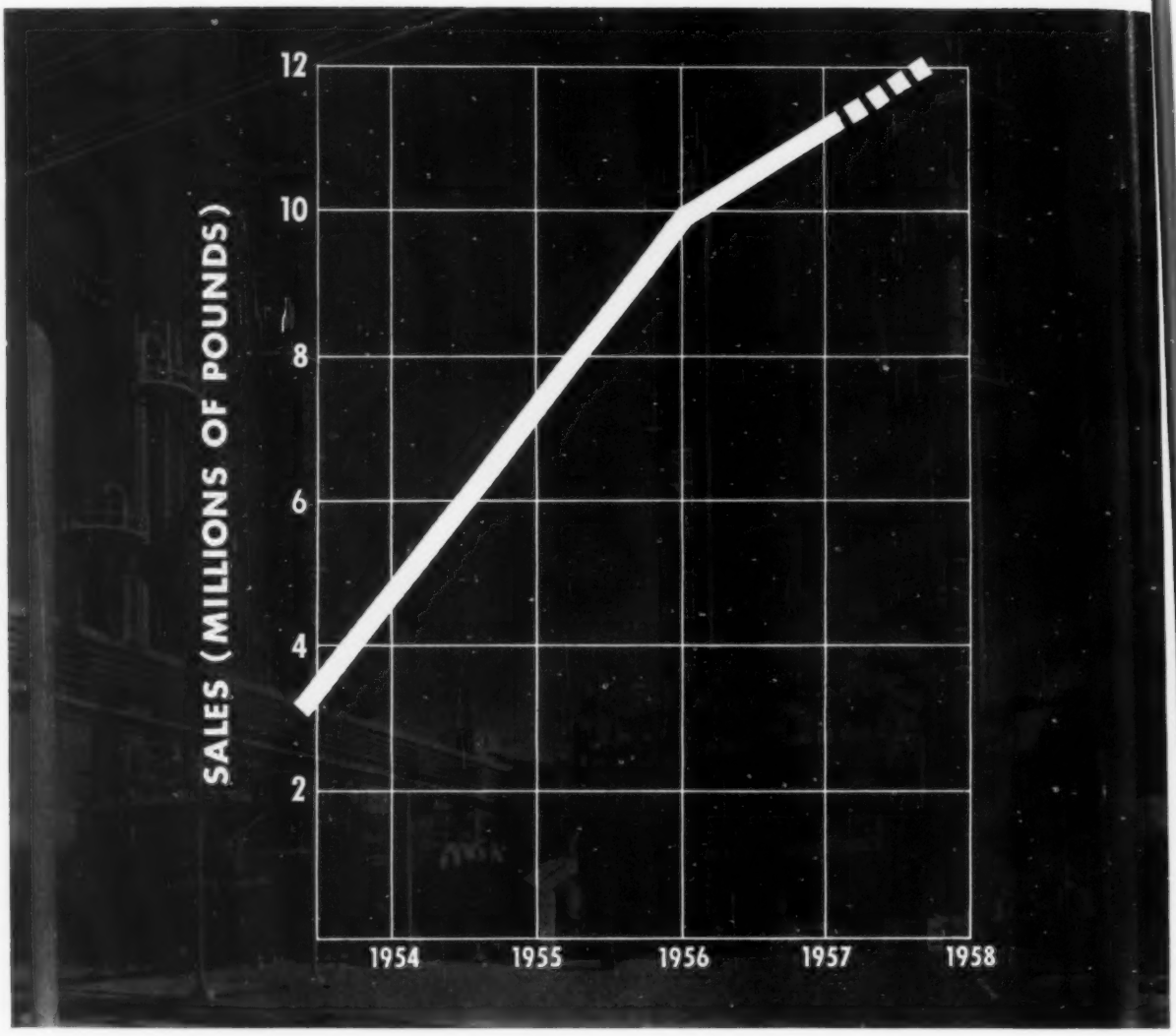


GOVERNMENT FIGURES PROVE AMAZING GROWTH OF DALPAC-TYPE ANTIOXIDANTS

Figures of the U. S. Tariff Commission show the astounding growth of di-tert-butyl-p-cresol in just three years—almost tripled!

Dalpac 4, Hercules di-tert-butyl-p-cresol, has firmly established itself as a leading antioxidant in many industries where hydrocarbon stability is a problem. Petroleum refiners, for example, rely on Dalpac to inhibit gum formation, stabilize gasoline color and prevent engine deposits. They use it in turbine and transformer oils to prevent deterioration. Dalpac 4 has no effect upon electrical properties, which makes it ideal for use in transformer oils.

These are but a few indications of where this Hercules antioxidant can serve you. Since Hercules is a basic integrated producer starting with the raw material, you can count on a dependable source of supply. We will be glad to answer your inquiries and send technical information.

DALPAC® 4

Oxychemicals Division • Naval Stores Department
HERCULES POWDER COMPANY
INCORPORATED
900 Market Street, Wilmington 99, Delaware

Admex Product-of-the-Month

Practical Beauty FOR FLOORS AND COUNTERS IN ATTRACTIVE VINYL COVERINGS BY THE SANDURA COMPANY

Beautiful floors that are a breeze to keep up are easy to install with Sandran vinyl products made by the Sandura Company of Philadelphia. They make attractive, durable coverings for counter tops and walls, too.

Flexibility and durability are built in because Sandura uses ADM's Admex vinyl plasticizers in all Sandran products. Admex advantages start in the mill, with better handling qualities during processing. The finished product gains permanence and color stability because Admex is a stabilizer as well as a plasticizer. This means important economy, too, because Admex can replace part of the stabilizer. Admex is non-migrating and resists extraction by water, detergents or household solvents.

There is an Admex plasticizer for your formulating problem. Why not write today for technical data and samples?

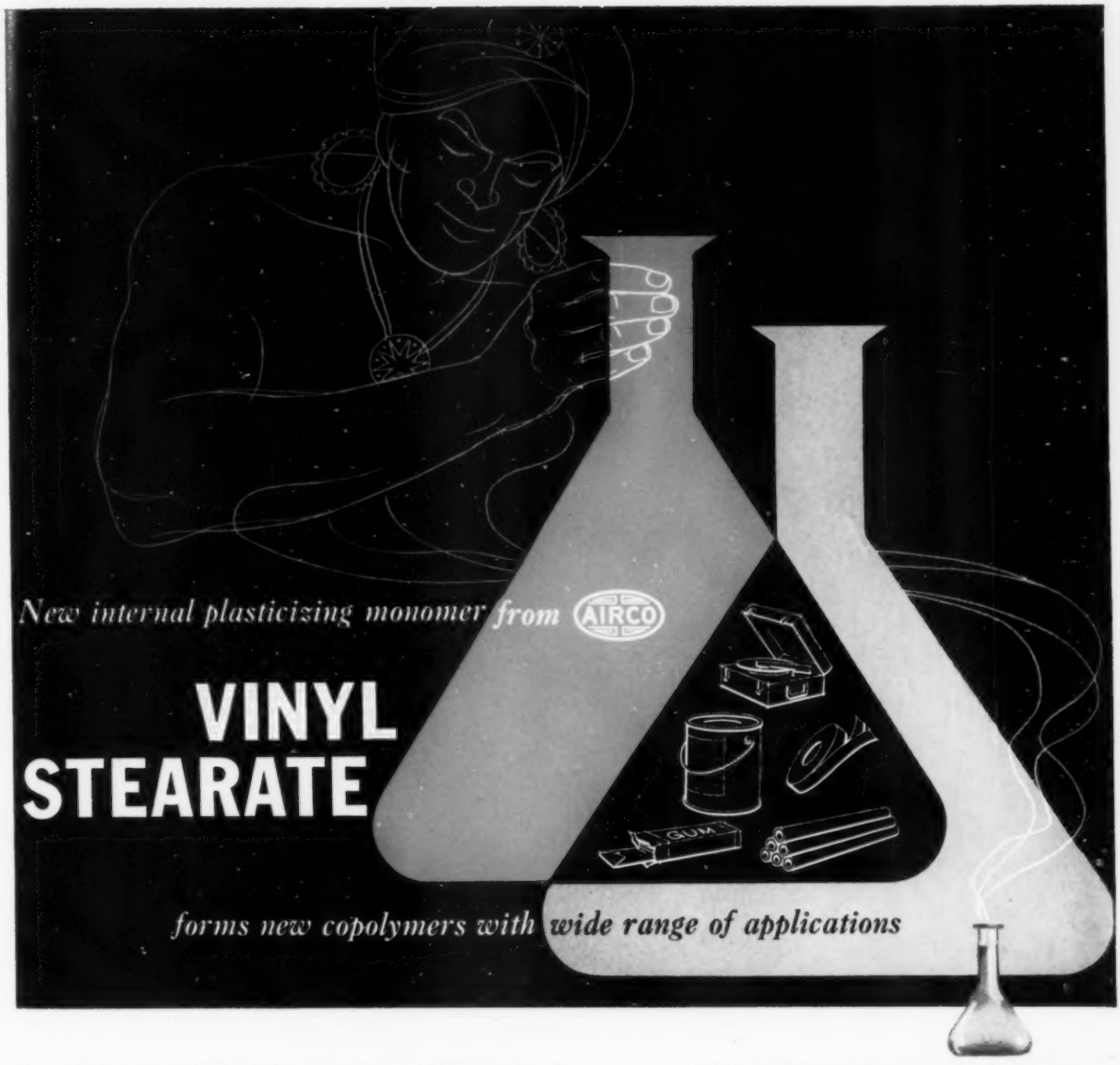
Admex
Vinyl Plasticizers

ADM PRODUCTS: Linseed, Soybean and Marine Oils, Synthetic and Natural Resins, Fatty Acids and Alcohols, Vinyl Plasticizers, Hydrogenated Glycerides, Sperm Oil, Foundry Binders, Bentonite, Industrial Cereal, Vegetable Proteins, Wheat Flour, Dehydrated Alfalfa, Livestock and Poultry Feeds.

Archer-Daniels-Midland

Archer QUALITY

717 INVESTORS BUILDING, MINNEAPOLIS 2, MINNESOTA



New internal plasticizing monomer from AIRCO

VINYL STEARATE

forms new copolymers with wide range of applications

Vinyl Stearate is a high molecular weight vinyl monomer that copolymerizes with vinyl acetate, vinyl chloride and other monomers to form copolymers with unusually versatile properties.

Vinyl Stearate copolymers have increased water resistance and greater solubility in common solvents. Vinyl Stearate imparts a high degree of flexibility to copolymers, prevents cracking or shattering of films and coatings. *This flexibility is permanent* — Vinyl Stearate copolymers will not bleed or wash out.

Vinyl Stearate is now available in commercial quantities for the first time in the U. S. The new AIRCO plant at Calvert City, Ky., with a capacity of 2,000,000 pounds a year, is on stream. Investigate Vinyl Stearate for vinyl copolymers. Write for newly expanded Bulletin V2A and a working sample. Or call our New York office: MUrray Hill 2-6700, Ext. 334.

Typical Applications of Vinyl Stearate Copolymer Intermediates —

Vinyl Stearate-Vinyl Acetate Copolymers: emulsion paints — textile finishing agents — adhesives — paper and board coatings — chewing gum base.

Vinyl Stearate-Vinyl Chloride Copolymers: Under 25% Vinyl Stearate by weight improves fabrication properties in plastic tubing, pipes, sheets, phono records, toys. 30-50% by weight produces flexible, internally plasticized copolymers for food packaging, wire and metal coatings.

Vinyl Stearate-Acrylonitrile or Acrylic Acid Copolymers: adhesives, coating materials, lubricating oil additives.

And in Addition: Vinyl Stearate forms promising copolymers with allyl butyrate, dialkyl maleates or fumarates, maleic anhydride; terpolymers with butadiene-styrene — butadiene-acrylonitrile, vinyl chloride — dialkyl maleates, maleic anhydride — organic nitrogen compounds, maleic anhydride — styrene.

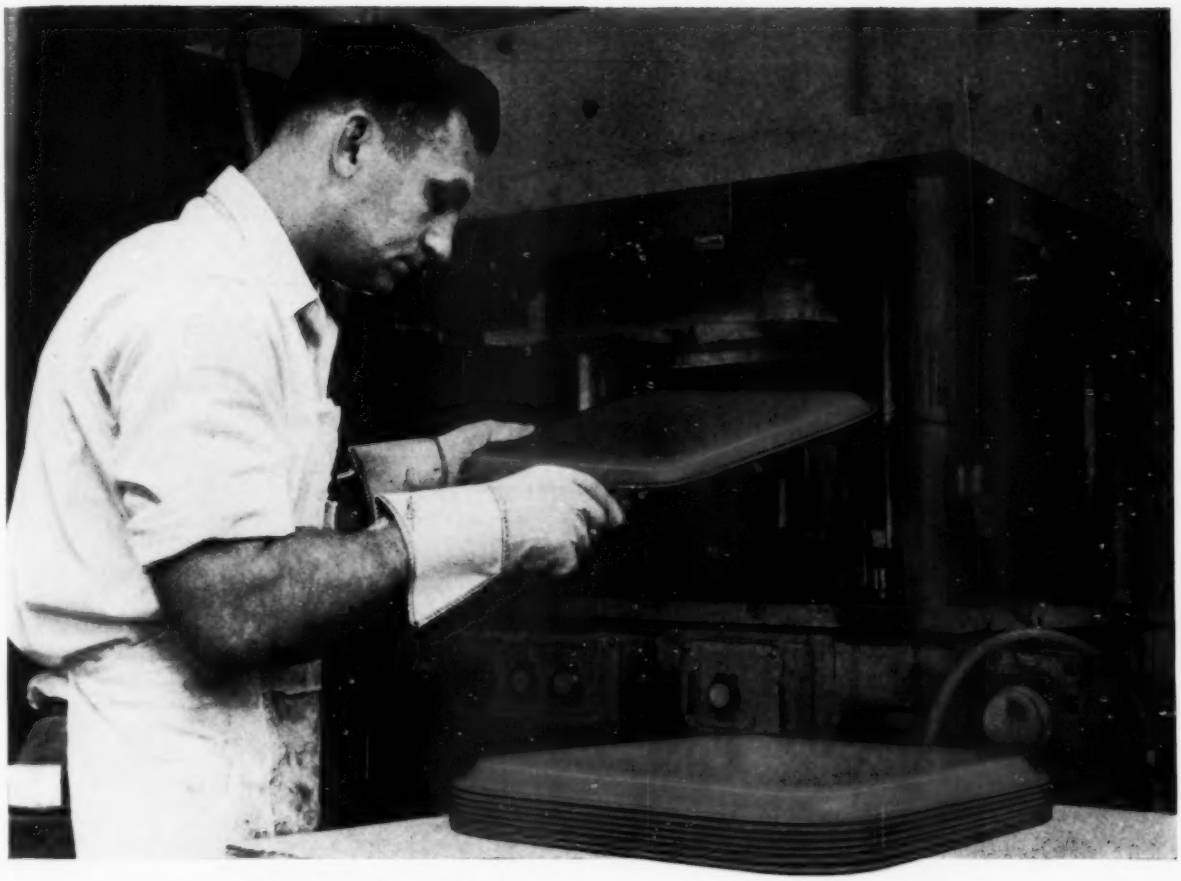
AIRCO®

AIR REDUCTION CHEMICAL COMPANY

A division of Air Reduction Company, Incorporated

150 East 42nd Street, New York 17, N. Y.

Represented Internationally by Airco Company International



For high-speed molding of reinforced plastics . . .

GLIDPOL 1012 polyester resin cures quickly, provides excellent "hot strength" and surface gloss!

GLIDPOL 1012 is recommended for molding and laminating—where good "hot strength", surface gloss and fast production rates are desirable. This rigid type polyester resin is capable of curing in short molding cycles, and is especially suited to the manufacture of a wide variety of reinforced plastic products.

Use all-purpose GLIDPOL 1012 for producing storage and mixing tanks, all types of containers, hoppers, tote boxes, trays and many other products. Glass fibers in conjunction with GLIDPOL 1012, produce a tough structural material that possesses excellent chemical resistance.

Write for details on how GLIDPOL 1012 can help you produce plastic products faster, better, more economically. Also available: GLIDPOL polyester resins for other fabricating techniques plus a complete range of fadeproof GEL-KOTE coatings that impart smoothness, durability, color appeal, to any reinforced plastic surface.

LIQUID RESIN PROPERTIES	
Viscosity @ 77° F.	800-1000 cps.
Polyester resin content	68%
Weight per gallon	9.5 lbs.
CURING RECOMMENDATIONS	
Catalysis	0.75 to 1.5% Benzoyl peroxide
Curing	1-2 min. @ 230°-250° F.
Pot life @ 77° F. 1% Benzoyl peroxide	10 days

QUALITY Glidden PRODUCTS

GLIDPOL POLYESTER RESINS

The Glidden Company • Industrial Paint Division
900 Union Commerce Bldg., Cleveland 14, Ohio

San Francisco • Los Angeles • Chicago (Nubian Division—1855 North Leclaire Avenue) • Minneapolis • St. Louis • New Orleans
Cleveland • Atlanta • Reading • Canada: Toronto and Montreal

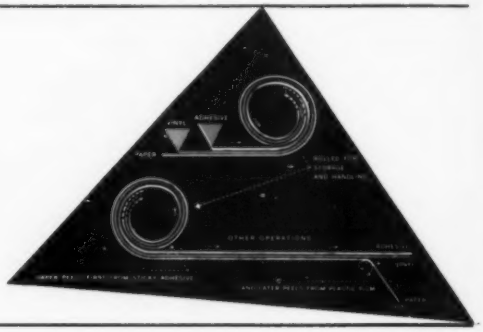
Solving unusual problems with Riegel papers

Rocket-Age Dictation... 10,000 digits a minute!

Mountains of data radioed by rockets in flight are captured photo-electrically on tape made of Riegel paper with unique physical, chemical and electrical properties. Tape is charged with static in form of image. This electrostatic "printing" is developed by dusting with powder, which clings only to charged areas. Image is "fixed" by heating paper's coating, fusing powder in position. It's all done in a wink!

Plastic Casting Paper and Release Paper...all in one!

Vinyl film is cast on one side of paper and cured at 400°F. Paper then serves as carrier while adhesive is applied to vinyl, and it's rolled for storage. When roll is unwound, release-coated back of paper peels easily from sticky adhesive, leaving vinyl and adhesive on base paper where it was cast. Later, the vinyl itself is stripped cleanly from paper!



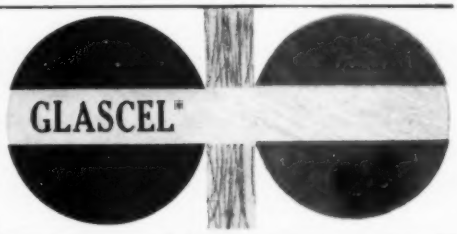
Life Insurance for Atomic-Age Machines ...and Men!

The grinding wear of dirt in high-speed engines . . . radioactive particles escaping into air . . . all spell death to atomic-age machines . . . and men. Riegel researchers have developed many highly technical, resin-impregnated filter papers for things like "absolute filters" in atomic installations, oil filters and air cleaners, battery separators, gas masks, vacuum cleaner bags.

Glass Reinforcing Material Made on Paper Machine!

Riegel's Glascel* is a thought-provoking new impregnating paper for plastic laminates. As a reinforcing material it gives better uniformity and *lower cost* than other non-woven glass materials . . . and higher strength than ordinary saturating papers. Glass content is variable from 5% to 90% to give just the right strength for each job. Long rolls, many weights, widths to 65 in.

*TM



OVER 600 RIEGEL PAPERS

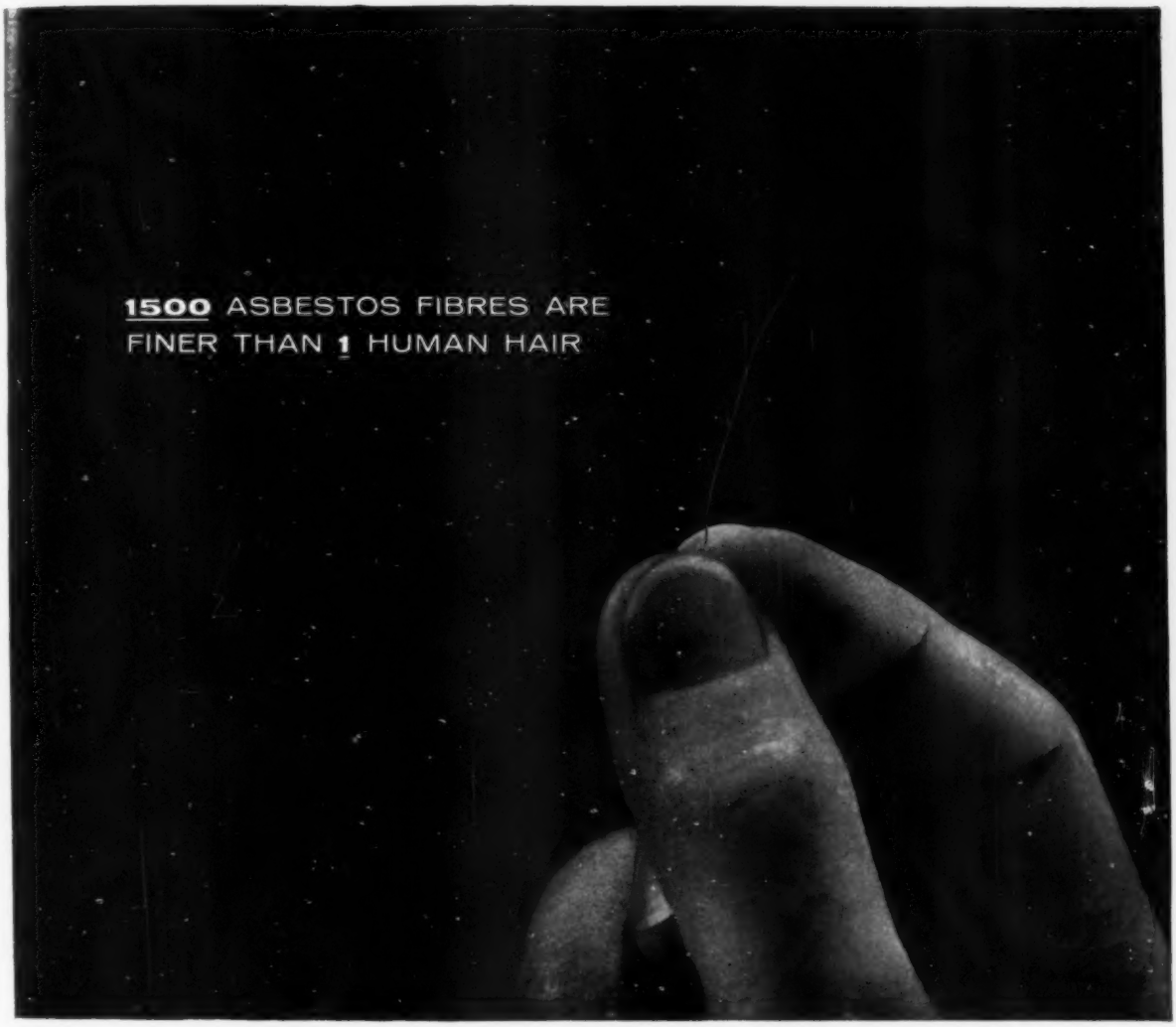
- Release papers for pressure sensitive adhesives
- Casting papers for films, adhesives and polyurethane foam
- Separating papers for plastic laminating
- Interleaving papers for tacky materials
- Resin-impregnated papers
- Heat-seal coated papers
- Laminations of paper, film or foil
- Polyethylene extrusions on paper, film or board

Riegel specializes in developing, manufacturing and converting *technical papers that solve problems.* More than 600 kinds have already been produced on our 14 paper machines. We'll be glad to give you a run-down. Tell us your problem . . .

Riegel

write to: TECHNICAL ADVISORY SERVICE
Riegel Paper Corporation, Box 250, New York 16, N. Y.

TECHNICAL PAPERS FOR INDUSTRY



The diameter of asbestos fibre in inches ranges from 7.06×10^{-7} to 11.8×10^{-7}. Shown above is not just one but a number of strands.

The **fineness** of J-M Asbestos Fibre assures higher loading, greater strength for your plastics

THE BROAD COVERAGE and dispersability of Johns-Manville Asbestos Fibre . . . plus its exceptionally high tensile strength . . . can add competitive advantages when used as a plastics reinforcer for products ranging from floor tile to molded electrical parts.

Compare the coverage of this J-M "magic mineral" with glass fibre: only 4,000 glass fibres to one linear inch . . . as many as 1,000,000 asbestos fibres in the same space!

Compare its amazing strength with ingot or wrought iron: greater than an equal thickness of either one!

In addition to these two outstanding properties, you will find J-M Asbestos Fibre, because it is of the Chrysotile variety, provides the best combination of properties offered by any filler on the market. It bulks, reinforces, controls impact strength, improves dimensional stability. In addition, you can depend on J-M Asbestos Fibre to reduce molding costs whether you work with thermoplastic, thermosetting, or cold-molded plastics.

If you would like more information on how you can improve plastics with the J-M "magic mineral," write for your free copy of brochure AFD-8A. Address: Johns-Manville, Asbestos Fibre Division, Box 1500, Asbestos, Quebec, Canada.

Characteristics of J-M Chrysotile Asbestos used in the Plastics Industry:

Type of Asbestos: Chrysotile
Specific Gravity: 2.4—2.6
Color: Dry: Light gray—Wet: Dark gray

Approximate Chemical Analysis:

MgO	40-42	FeO	Tr-6
SiO_2	38-42	Fe_2O_3	Tr-6
H_2O	12-15	Al_2O_3	Tr-3

JOHNS-MANVILLE JM PRODUCTS

WHEN GREATER WET STRENGTH, TRANSLUCENCY AND FLEXURAL STRENGTH ARE VITAL . . .

Specify

Garan® WOVEN ROVING

In production, Garan Woven Roving:

- **BONDS BETTER WITH RESINS**
- **WETS OUT 3 TO 5 TIMES FASTER**
- **CUTS LAY-UP TIME SUBSTANTIALLY**
- **PERMITS MORE UNIFORM LAMINATES**
- **CONFORMS WELL TO THE MOLD**

RESULT:
Stronger Reinforced Plastic Products at Less Cost; Increased Sales Acceptance

L·O·F Glass Fibers Co., pioneers in the development of the Garan binder, supplies these high-strength glass fibers to weavers who produce fabric in standard weights and sizes.

L·O·F GLASS FIBERS

L·O·F GLASS FIBERS COMPANY

For the Garan Roving Story: *write, Dept. 15-128, 1810 Madison Ave., Toledo 1, Ohio*

CORVEL† Fusion Bond Finishes—
Six new engineered resins for product finishing

Cellulosics • Vinyls • Epoxies • Nylon • Polyethylene • Polyethers

CORVEL finishes are specially processed dry powders, formulated for use in the patented* fluidized bed coating process. These finishes give you the following outstanding advantages:

- Comparatively heavy finishes (approx. 0.005" to 0.062") obtained by a single dipping treatment.
- No solvents used.
- Finishes unmarred by sags, drips or bridging.
- Uniformity of coating thickness.
- Excellent coverage of sharp edges, corners and projections.

Thus, CORVEL finishes can give your products improved durability and appearance at minimum cost.

Process licensing is now readily available. A process license is automatically extended to the purchaser of CORVEL powders from National Polymer Products, Inc. upon payment of a small royalty added to each sales invoice. General licenses to use the patented process are available from Polymer Processes, Inc., an affiliate company.

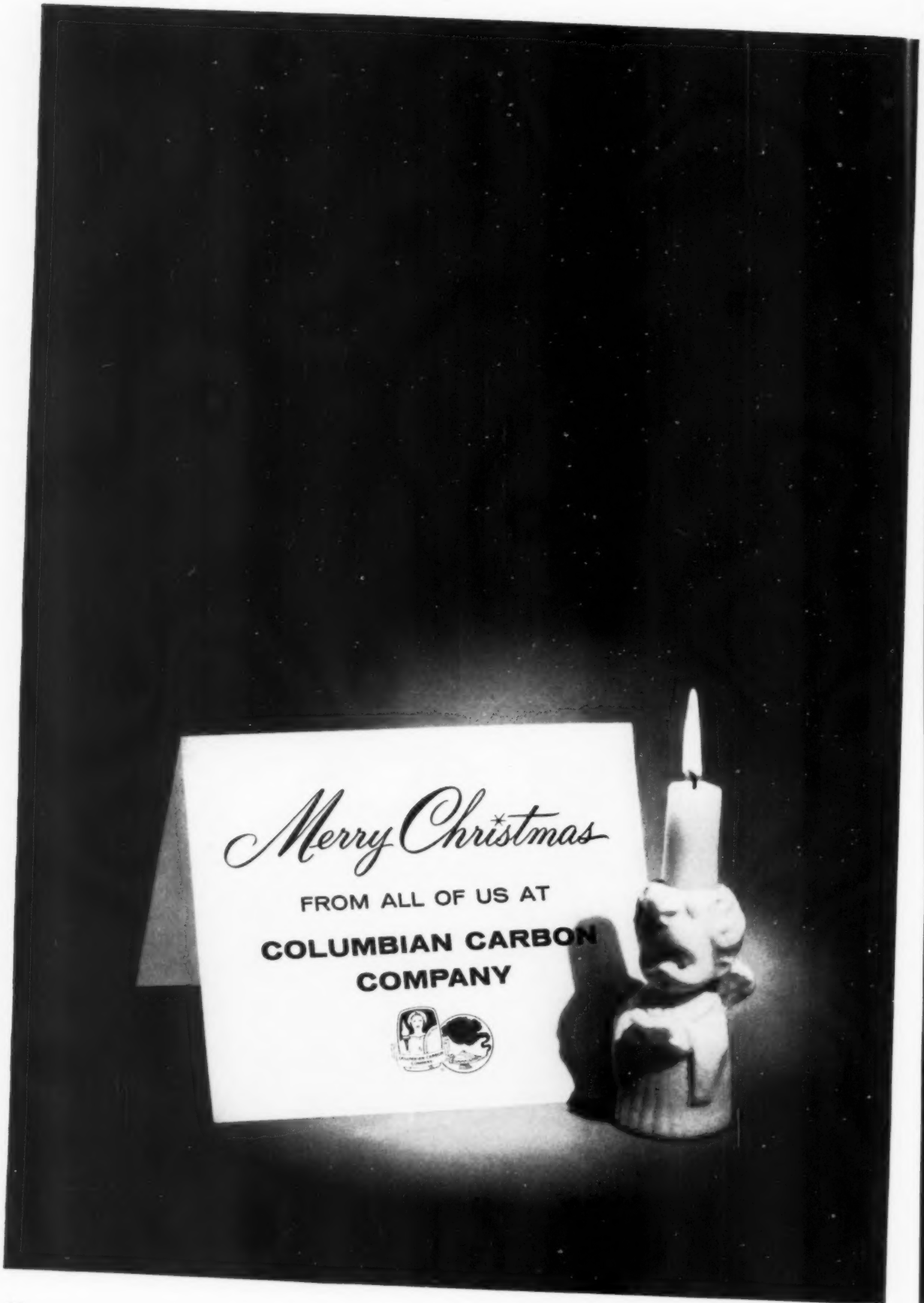
Information relating the advantages of CORVEL Fusion Bond Finishes to your particular products, and details on the fluidized bed process and equipment are available. Write today for a copy of the new CORVEL Bulletin.

NATIONAL POLYMER PRODUCTS, INC. / Reading, Pennsylvania

A subsidiary of The Polymer Corporation

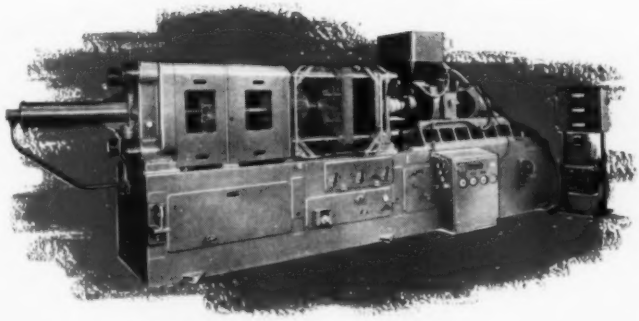
POLYPENCO®

†Polymer Corporation trademark for finishing materials
**U. S. Patent 2,844,489 and over 30 patents pending*


Merry Christmas
FROM ALL OF US AT
COLUMBIAN CARBON
COMPANY

When only the Best is good enough –*choose* WINDSOR

Every machine in the Windsor range is of sound design and workmanship, produced to the fine standards of precision which have made Windsor first and foremost in plastics engineering. Choose wisely . . . choose Windsor!



Fully illustrated literature available on request.

THE WINDSOR AP.2088 An extremely versatile pre-plasticising model designed for hand and semi-automatic cycle control. A popular machine for the high-speed production of top quality mouldings up to 64 ounces per shot over a projected moulding area of 300 square inches.

The complete Windsor range includes Injection Moulding Machines in capacities of from 1 to 200 ounces and Extrusion Machines with outputs up to 500 lbs. per hour.

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VACUUM FORM IN A BIG WAY with HI-FAX®

Now it is possible to combine the economy of vacuum forming with the outstanding properties of Hi-fax high-density polyethylene. These commercially available tote boxes are a good example of how Hi-fax is helping to make good products even better. Rigid, strong, lightweight, resistant to heat and chemicals, the boxes were produced on a fully automatic rotary vacuum forming press.

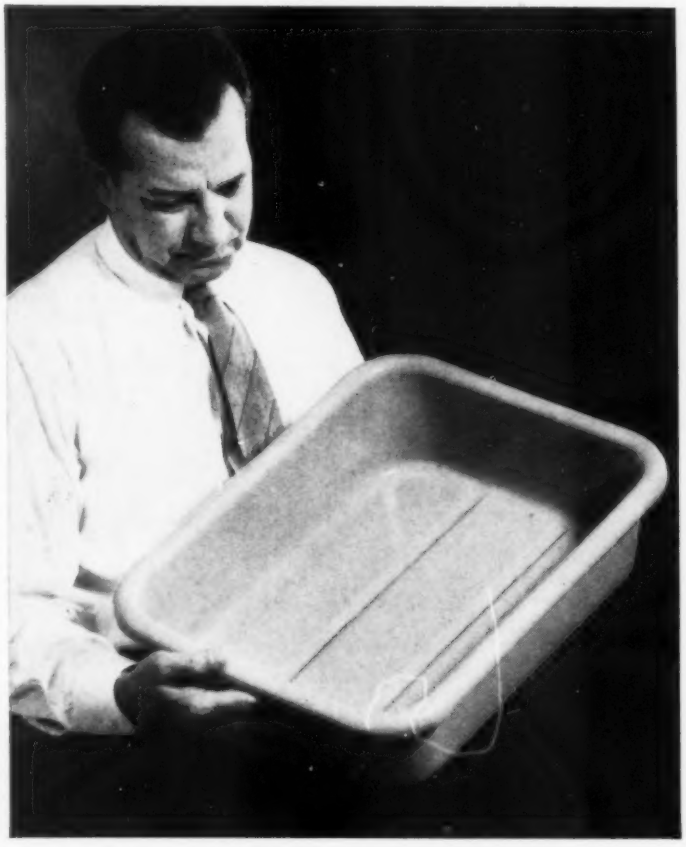
For superior stress crack resistance and toughness more and more manufacturers are turning to extruded sheet based on Hi-fax—the plastic that's different! Perhaps Hi-fax extrusions can provide the solution to your own processing needs. For further technical information, write:

Cellulose Products Department

HERCULES POWDER COMPANY

900 Market Street, Wilmington 99, Delaware

CPS6-7



SMOOTH, GLOSSY SURFACE is one of the features of these tote boxes. They are commercially available in two sizes.

RIGID STRENGTH is a "built-in" feature with Hi-fax. Tote box was vacuum formed by **Jewel City Products,** Los Angeles, with sheet extruded by **Jet Specialties Co.,** Los Angeles.

CHEMICAL RESISTANCE to food greases, oils and other corrosive materials makes Hi-fax ideal for products that must withstand unusual conditions.

For greater strength and workability . . . at lowest cost!

You'll find the new UNIFORMAT® *still better* in three important ways. Even more uniform in weight and fiber distribution. More uniform in binder content for easier, faster wetting out. Closer tolerances in edge trimming. All now yours at no extra cost!

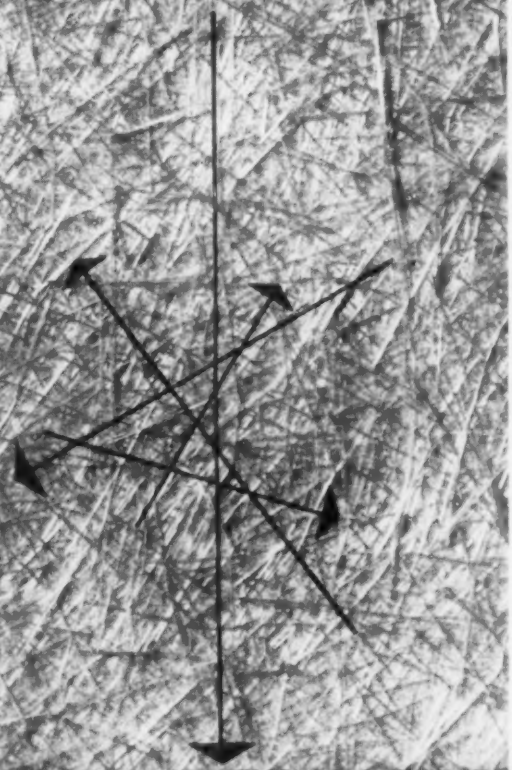
Precision machines, automatic controls and Ferro's roll-by-roll quality checks assure that you get just what you order. So, for *open-mold* or *matched metal die* production, try UNIFORMAT! Compare your results, and your costs! Write for specifications, samples, prices.

FERRO

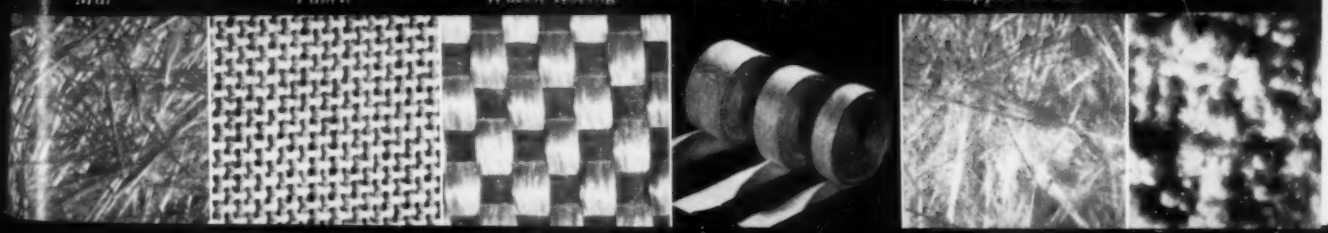
FERRO CORPORATION
FIBER GLASS DIVISION
Nashville 11, Tenn. . . . Huntington Beach, California
Other Ferro plants in Argentina, Australia, Brazil, Chile, England, France, Holland, Hong Kong, Japan, Mexico and South Africa. Write for full addresses.

FERRO UNIFORMAT

NOW BETTER 3-WAYS!

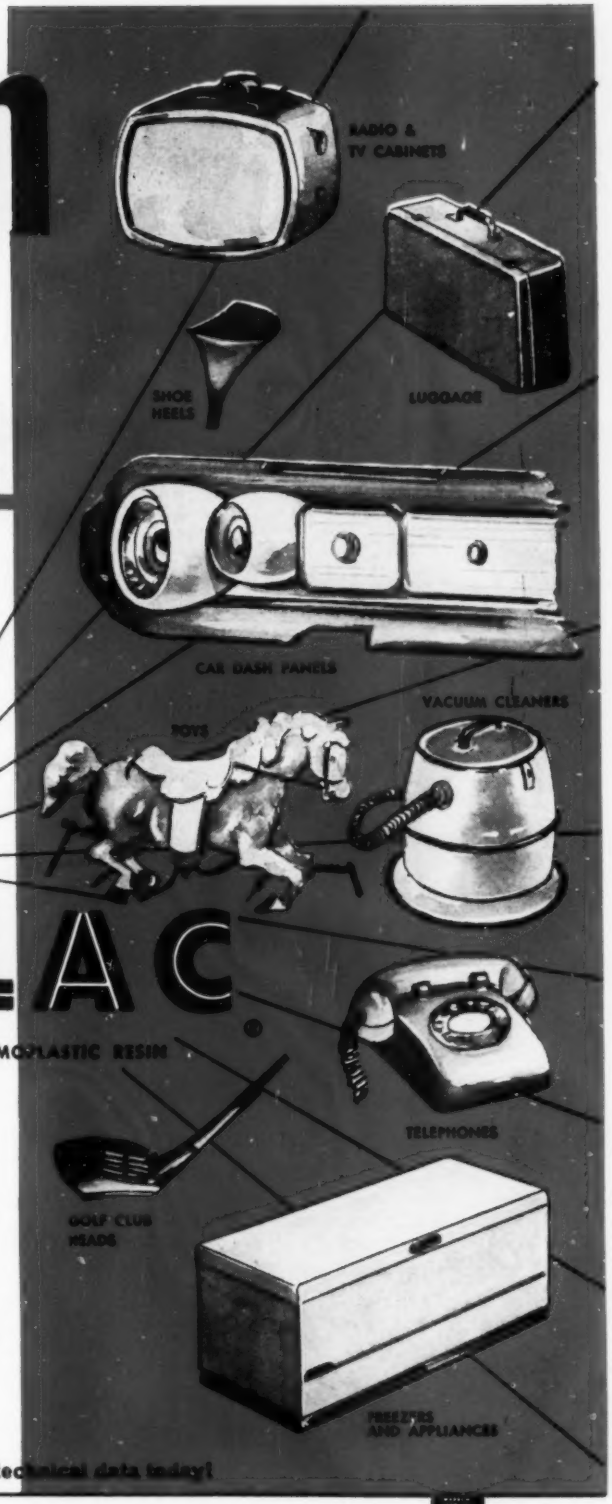


Check FERRO first . . . for your complete fiber glass needs!



design with assurance!

Cycolac can work design wonders for you. Extensively used in a host of end-use products similar to those illustrated here, Cycolac can help you design finer, more attractive-looking products—premium quality merchandise that stresses sturdiness, easier assembly, faster production and lower costs. Yes, to design it with full assurance, specify Cycolac.



CYCOLAC®

HIGH-IMPACT THERMOPLASTIC RESIN

...molded parts, extruded profiles, calendered sheets.

This family of single uniform resins provides a unique balance of properties, permitting fast molding, calendering and extruding. It is economical to form Cycolac press-polished sheets by vacuum, air-pressure, or mechanical methods over inexpensive molds of wood, plaster, aluminum, etc.

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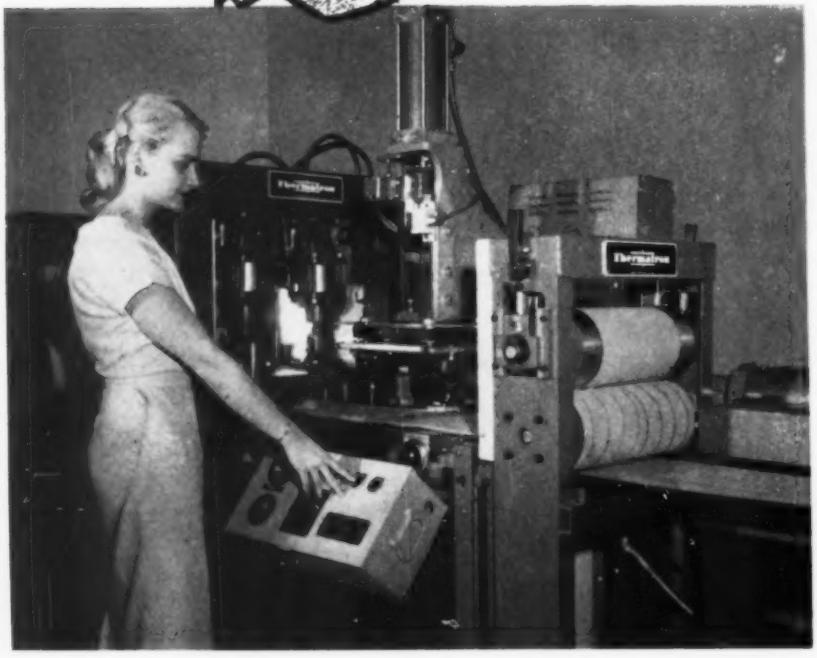
BW ® Marbon

bumper crop of baby pants!

PRODUCED BY THE THOUSANDS ON COMPLETELY AUTOMATED

THERMATRON

ELECTRONIC WELDING EQUIPMENT



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This completely automatic THERMATRON unit folds, punches, cuts, welds and trims plastic pants for junior at a fantastic rate of production. Feeding is uninterrupted and there's only supervisory labor. Just push the button and THERMATRON produces baby's wardrobe from the vinyl roll in one continuous operation.

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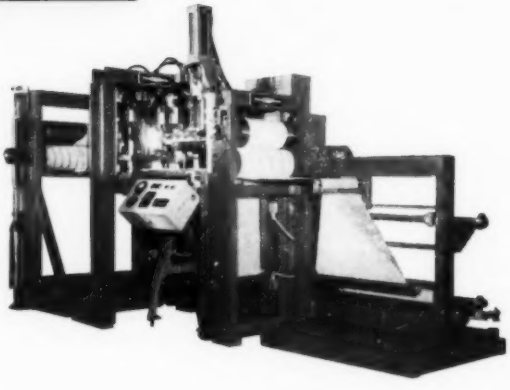

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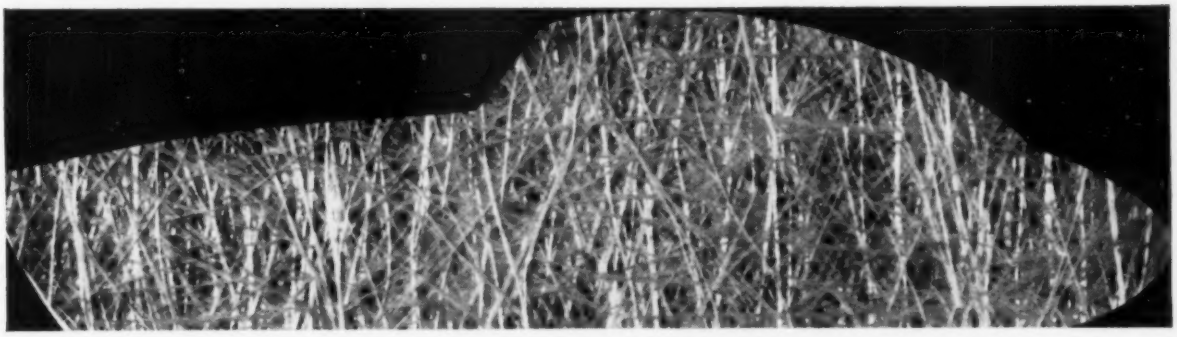

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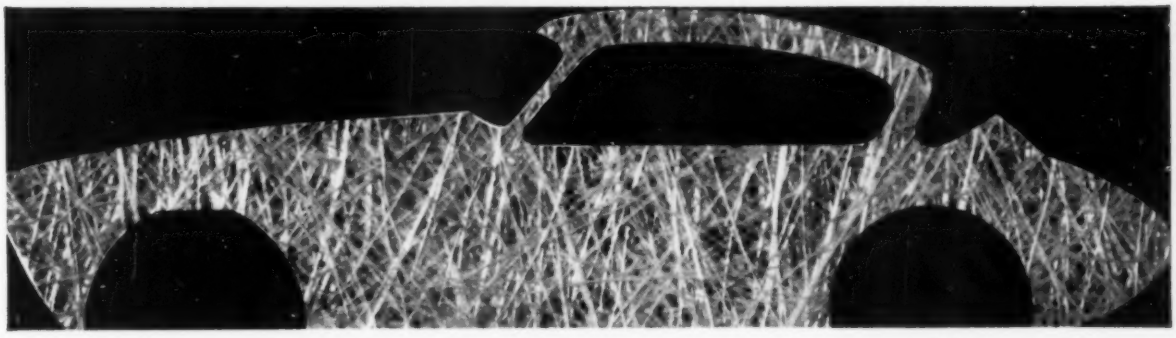

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Jensen 541 series 'R' (Jensen Motors Ltd., Staffs) with reinforced plastic body incorporating Deeglas Chopped Strand Mat

TITANOX* to the rescue! Part of the appeal of vinyl-covered furniture lies in its light or pastel finish . . . and part of the appeal of TITANOX titanium dioxide white pigments is how economically they produce properties of whiteness, brightness and opacity in plastic or rubber stocks. Whether your formula calls for TITANOX-RA, TITANOX-RA-50 or TITANOX-RA-NC, you'll find these leading white pigments a pleasure to work with—in uniformity that permits easy regulation of opacity and tint, in the contribution they make to product durability, and in ease of processing. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y.; offices and warehouses in principal cities.

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*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.

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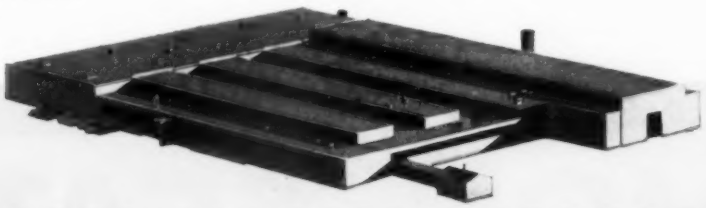
This light weight grease gun made of tough Tenite Butyrate plastic develops 3000 lb. pressure per square inch. The amber body allows full visibility of the grease supply while the 3" nozzle provides the necessary length to get at those hard to reach fittings. Lighter weight for lower shipping costs, bright colors for sales appeal plus low manufacturing costs without sacrificing quality add up to a good marketable product and a satisfied customer.

A complete service from "START TO FINISH" is ready to work for you to solve your problems.



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"MOPLEN" is particularly suitable for the production of the following articles:

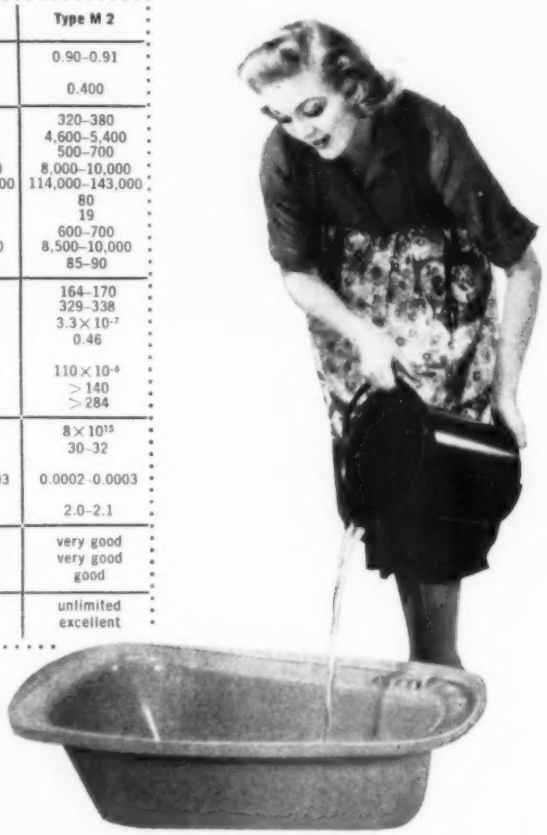
- **household articles**
- **electrical domestic appliances**
- **equipment for the textile and dyeing industries**
- **sanitary articles**
- **toys**
- **electrical, electronic, radio and television equipment**
- **automotive industry items**
- **pipes and structural shapes**
- **sheets**
- **transparent films, colored and colorless**
- **cables and wire coverings**
- **containers, bottles, flasks, beakers, basins, tubs**
- **chemical equipment**
- **fishing equipment**

Montecatini polypropylene also lends itself to the production of filaments, yarns and staple fibers suitable for many textile applications.

For more detailed information about "MOPLEN" please write, outlining area of interest, to

Chemore Corporation
General Representative in U.S.A. & Canada for Montecatini
21 West St., New York 6, N. Y.

	Properties	Method of Measuring	Units of Measurement	Type M 1	Type M 2
General	Specific gravity	ASTM D792-50	kg/l.	0.90–0.91	0.90–0.91
	Apparent density (granular form)	ASTM D392-38	kg/l.	0.400	0.400
Mechanical	Ultimate tensile strength	ASTM D638-52T	kg/cm² / lb/in²	300–350 / 4,300–5,000	320–380 / 4,600–5,400
	Total elongation	ASTM D638-52T	%	500–700	500–700
	Stiffness (flexural)	ASTM D747-50	kg/cm² / lb/in²	9,000–12,000 / 130,000–170,000	8,000–10,000 / 114,000–143,000
	Impact strength Izod test unnotched ½" × ½" bar	ASTM D256-54T	kg cm/cm² / ft lb/in	80 / 19	80 / 19
	Compressive strength	ASTM D695-54	kg/cm² / lb/in²	666–766 / 9,500–11,000	600–700 / 8,500–10,000
	Hardness Rockwell	ASTM D785-51	R-scale	90–95	85–90
Thermal	Melting Point	crystallographic microscope	°C / °F	164–170 / 329–338	164–170 / 329–338
	Thermal conductivity	—	k cal sec, cm², °C, cm	3.3×10^{-7}	3.3×10^{-7}
	Specific heat	—	k cal/gm, °C	0.46	0.46
	Coefficient of thermal expansion	ASTM D696-44	1/°C	110×10^{-6}	110×10^{-6}
	Softening point (Vicat – 1 Kg)	DN 57302	°C / °F	>140 / >284	>140 / >284
Electrical	Volume resistivity	ASTM D257-54T	ohm • cm	8×10^{15}	8×10^{15}
	Dielectric strength	ASTM D149-55T	kV/mm	30–32	30–32
	Dissipation factor (10^6 cycles/sec.)	ASTM D150-54T	—	0.0002–0.0003	0.0002–0.0003
	Dielectric constant (10^6 cycles/sec.)	ASTM D150-54T	—	2.0–2.1	2.0–2.1
Chemical	Chemical resistance	ASTM D543-52T	—	very good	very good
	Alkali resistance	ASTM D543-52T	—	very good	very good
	Solvents resistance	ASTM D543-52T	—	good	good
	Dyeability	—	—	unlimited	unlimited
	Processing characteristics	—	—	excellent	excellent



Pails and basinettes, that will easily withstand boiling water, are but two of the many items that can be made from Montecatini's "MOPLEN"* polypropylenes.

Offering unusually high heat resistance; excellent resistance to solvents, acids and bases, and other chemicals; high strength characteristics; and good electrical properties, products made from "MOPLEN" also exhibit fine detail, high finish and surface hardness and may be molded and extruded in any desired color.

*Montecatini Trademark

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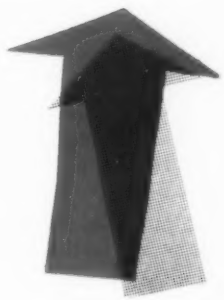
Soc. Gen., Milano, Italy

U. S. Representatives: CHEMORE CORPORATION • 21 WEST STREET, NEW YORK 6, N. Y. HANOVER 2-5275

Opal 040 Flat and Corrugated 'Perspex' acrylic sheet is used by Personalised Plastic Signs Pty., Ltd., Australia, to make the illuminated faces of this large sign.

'Perspex' for signs



THIS 40 ft. x 10 ft. sign in Australia is made by Personalised Plastic Signs Pty., Ltd., Australia. The top section 6 ft. deep and the script letters are faced with opal 040 flat 'Perspex' sheet. Background and letters are internally illuminated with 20 mm. tubing.

The lower section 4 ft. deep is opal 040 corrugated 'Perspex' with flat Blue 'Perspex' cut out letters, changed by sliding along H channels. This section is illuminated by 8 ft. 25 mm. cold cathode tubing.

'Perspex' was chosen because its unique properties make it ideal for every sort of sign by day and night. It is tough and ensures minimum breakage during installation. It stands up to weather conditions in all parts of the world and is impervious to corrosive atmospheres in most industrial areas.

'Perspex' is an attractive, hardwearing material, easily shaped into novel and interesting designs. It has a high light transmission and is available in a wide range of transparent, translucent and opaque colours.

'PERSPEX'

'Perspex' is the registered trade mark for the acrylic sheet manufactured by I.C.I.

Imperial Chemical Industries Limited, Plastics Division: Export Dept., Black Fan Road, Welwyn Garden City, Herts.

U.S.A. enquiries to :
J. B. Henriques Inc., 521 Fifth Avenue, New York 17, N.Y.

Canadian enquiries to :
Canadian Industries Ltd., Plastics Dept., Box 10, Montreal, P.Q.

ICI
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Plastic Hubs for Roller Skates Molded Economically with Lustre-Die

They needed an injection molding die capable of forming plastic roller-skate hubs by the tens of thousands—a die which would be economical for long runs, and yet have the ability to impart an unusually high sheen to the finished product.

DISTRIBUTOR SAYS, "LUSTRE-DIE."

The die-maker, Plas-Tool Co., Skokie, Ill., put the problem up to our local tool steel distributor, Peninsular Steel Co., who recommended Lustre-Die tool steel on the basis of past experience.

PRODUCES 7 MILLION PIECES

The 24-cavity die was put to work in an 8 oz press, molding rigid polyethylene. The plastic parts were molded by Precision Plastics, Inc., Mishawaka, Ind. The performance of the die was excellent, for the manufacturer was able to produce more than 7 million sparkling pieces. And there wasn't any need for redressing.

LUSTRE-DIE TAKES HIGH POLISH

Lustre-Die is just the ticket for plastic molding because it takes such a bright polish. In fact, its basic analysis is perfect for working with plastics. But to further improve its excellent properties, we add a special alloy fortification; and we furnish the steel oil-quenched and tempered, ready for machining and polishing.

Lustre-Die is melted in the electric furnace, and is painstakingly inspected to insure cleanliness. It's free from porosity and surface pitting. Best of all, it takes a mirror-like finish.

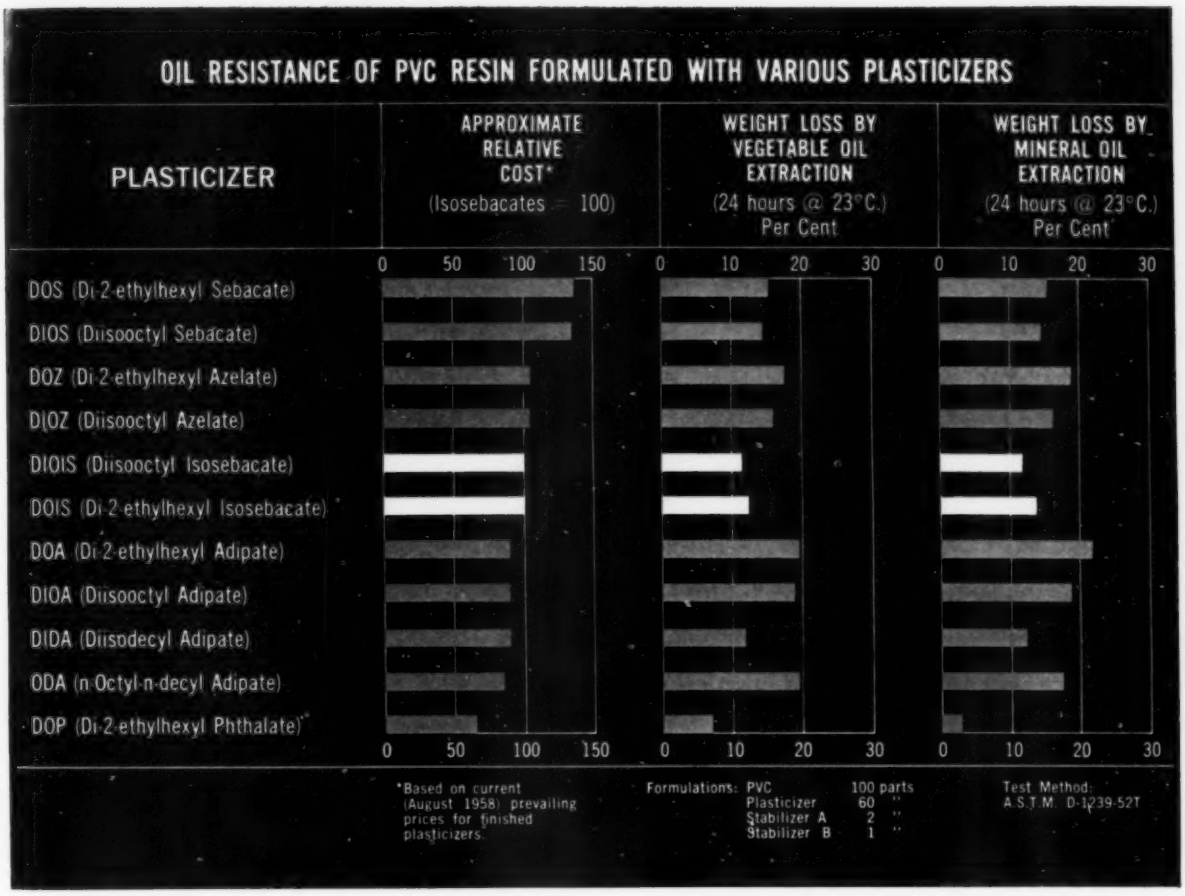
Choose Lustre-Die for your next plastic-molding job. Your Bethlehem tool steel distributor carries it in stock, and will be pleased to work with you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM TOOL STEELS

BETHLEHEM STEEL



Esters of ISOSEBACIC® acid show lower oil extraction than more costly vinyl plasticizers

Dioctyl and diisooctyl esters of ISOSEBACIC acid, used as low-temperature plasticizers for polyvinyl chloride, outperform the sebacates, azelates and adipates in resistance to both mineral and vegetable oils. This is shown in the accompanying data from a series of recent tests, along with approximate relative costs of these commonly used vinyl plasticizers.

Oil resistance is a prime requirement of plasticized vinyls for such applications as auto seat covers, garden hose, wallets and footwear. With ISOSEBACIC acid-derived plasticizers, manufacturers can turn out products with superior oil resistance . . . and excellent color, odor, low-temperature flexibility and heat stability as well.

Test Procedure

These oil extraction tests were carried out on 2" disks die-cut from 10- to 20-mil sheeting prepared by standard milling and pressing procedures. A refinement in the A.S.T.M. method used was pre- and post-conditioning of specimens for 40 hours at 23-24°C. and 50% r.h. before weighing.

DOP was included in these tests since it is relatively inexpensive and is commonly blended with the other plasticizers to increase their compatibility. Although DOP has good oil resistance, it is not used to impart low-temperature flexibility when incorporated in vinyl resins.

New Intermediate Being Evaluated

ISOSEBACIC acid is a new synthetic organic intermediate soon to be produced in commercial quantities at the U.S.I. Tuscola, Ill., plant. It is a mixture of three C-10 dibasic acids – 2-ethyl suberic, 2,5-diethyl adipic and sebacic acids. In addition to its promise as a vinyl plasticizer intermediate, it is being evaluated for polyamides, polyesters, polyurethanes and alkyd resins.

Its interesting properties may offer you opportunities for significant product improvement and cost reduction. Write for samples and literature.

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NOW AVAILABLE FOR *rigid or flexible* URETHANE FOAMS

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FOR FLEXIBLE FOAMS

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For the production of high-quality flexible urethane foams, adaptable to both "one-shot" and prepolymer foaming systems. Widely applicable in industries such as automotive, aviation, furniture, clothing, packaging, bedding, sports equipment, and many others.

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Foaming systems for producing low to high density foams possessing excellent structural strength, uniform cell structure, heat and dimensional stability. Can be foamed in place by batch, continuous or intermittent machine mixing or spray foaming methods.

Rigid foam uses: thermal insulation (refrigerators, freezers, pipes, tanks, etc.); structural reinforcement (core material for structural sandwich panels, wall panels, etc.); potting or encapsulation of electric components; flotation equipment.

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NEW 812 chrome roll unit

with 8" top roll
and two 12" lower rolls

for greater sheet production
— closer temperature control

An 8" top roll and two 12" lower rolls mean greater sheet production, plus a finer quality sheet in this new 812 Chrome Roll Unit. New interior roll design allows greater circulating capacity affording increased heat transfer and closer temperature control. These improvements combined with the super finished surface of the chromium roll produce a consistently higher quality sheet. Greater accuracy in holding sheet dimensions is now possible by improved air actuation of the rolls with precision adjustable stops.

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For No. 812 Chrome Roll Unit

The Robbins No. 812 Chrome Roll Unit is available with the following accessories: Lamination Roll Mount. Embossing Roll. Built-in or Portable Heat Exchanger in either open or closed system. Direct Current Drive for closer speed control. Safety Device for chrome rolls. Casters. Quick Disconnect Couplers — water or electrical. Idler Conveyor Section. Air Compressor. *Write for descriptive literature.*

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1430 Mishawaka Street, Elkhart, Indiana

Robbins
never say die . . . say Robbins die

Subsidiary of Lynch Corp., Anderson, Ind., U. S. A.

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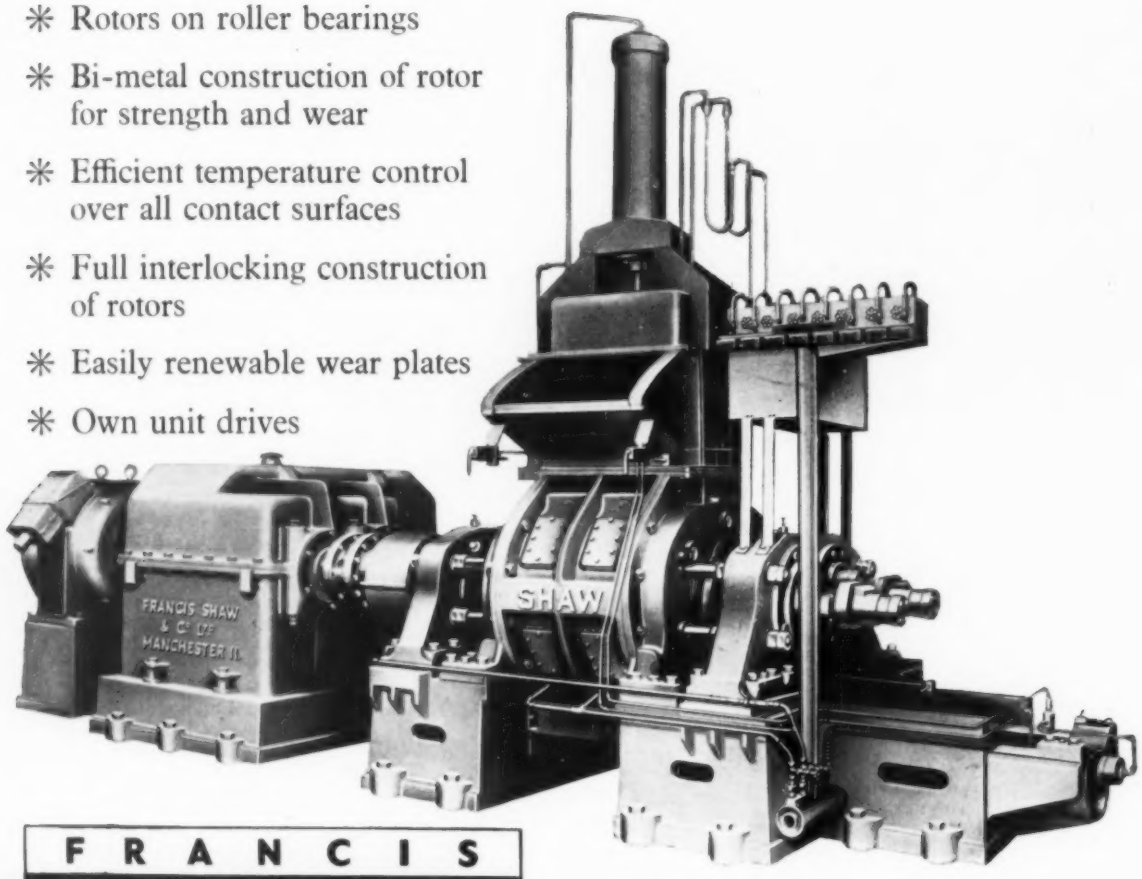

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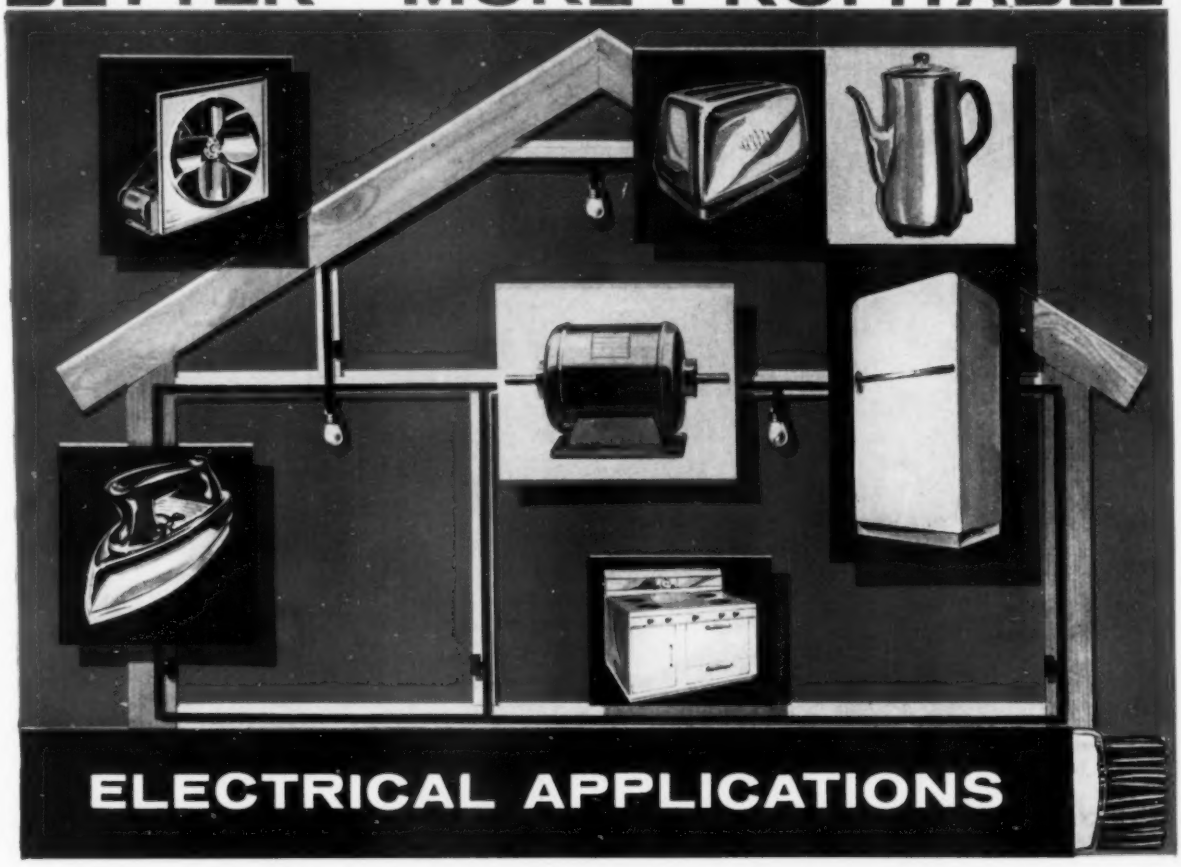

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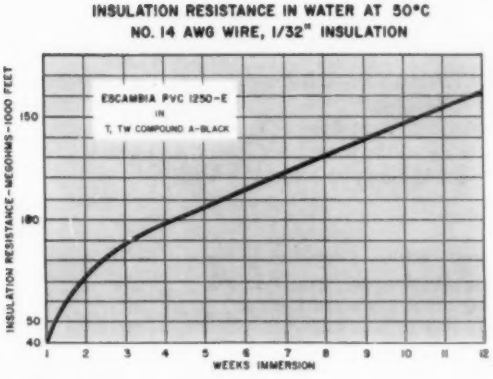

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This resin is now on the UL interchangeability list—ready to bring you products that will please your customers and profits that will please you. See for yourself what this resin can do—make a trial run in your plant now.

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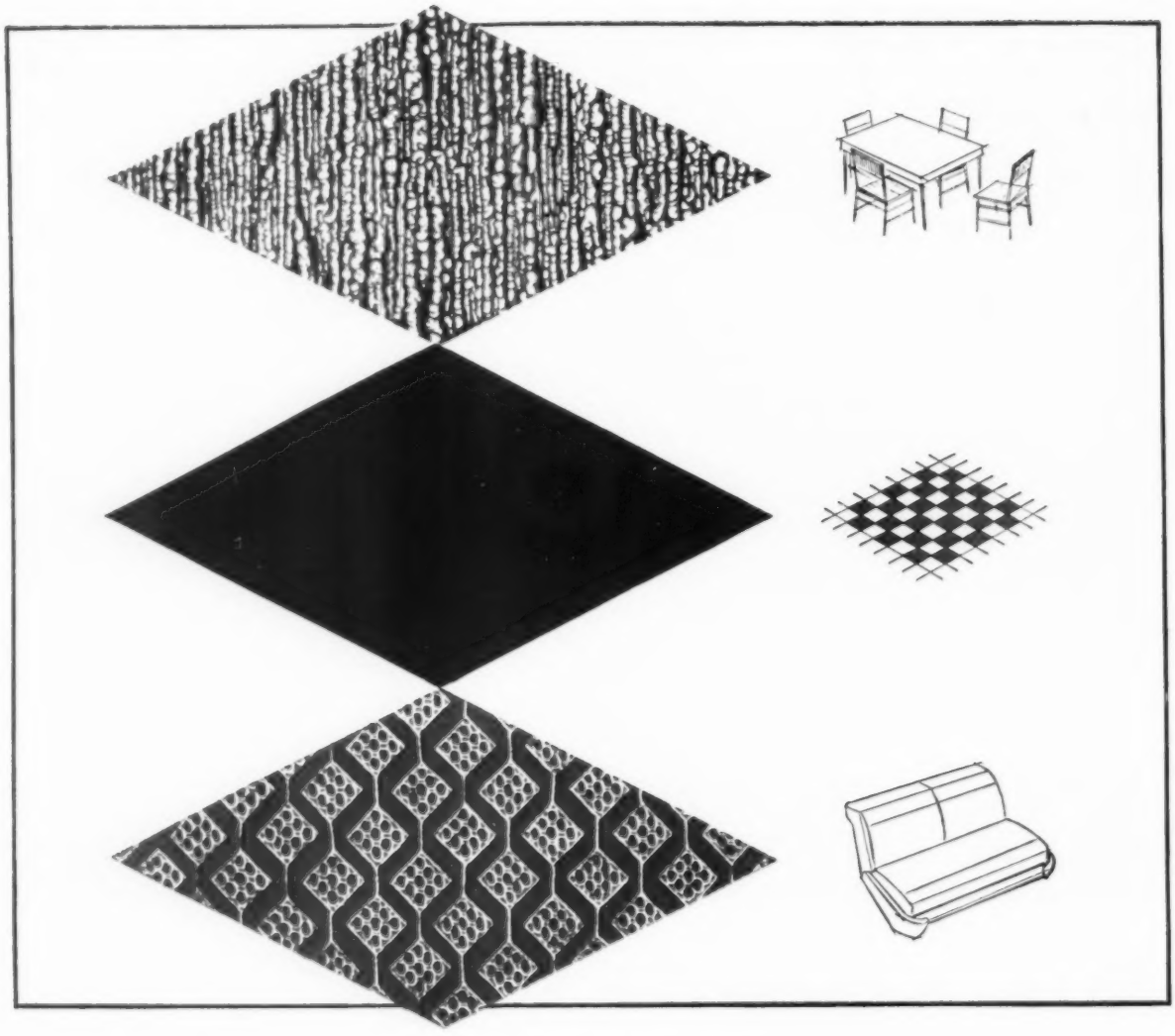

Plastolein® 9720 is the answer to low-cost polymeric permanence!

Only a polymeric plasticizer can give your vinyl products the permanence your customers want. And of all polymerics, Plastolein 9720 is the lowest in cost.

You get versatile all-around utility from Plastolein 9720. Outstanding permanence. Easy processability. High efficiency. Excellent compatibility. You get low temperature flexibility that other polymerics fail to match. And the comparatively low viscosity of Plastolein 9720 provides added savings from bulk storage and easy handling.

Remember, Plastolein 9720 gives you polymeric *permanence*, at the lowest possible cost. Get the facts by sending the coupon below.

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Emery Industries, Inc., Dept. F-12,
Carew Tower, Cincinnati 2, Ohio
Please send 32-page Emeryfacts describing the Plastolein Plasticizers.

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Company_____

Address_____

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Don't miss . . . in this issue

The future of custom processing. With mergers and acquisitions, both horizontally and vertically, with increasing announcements of captive plant activity on the part of end-users, with decisions to be made concerning the advantages and disadvantages of proprietary product activity on the part of custom molders or custom activity on the part of proprietary molders, there is much confusion in the field. Out of a three-month survey involving correspondence and visits with custom processors, captive plant executives, material makers, and machinery men has come a pattern of polemics, but also a great deal of valuable opinion from which direction may be drawn. This survey was the basis of the article which begins on p. 87.

What kinds of polyethylenes for films? This is the second article in the series which began in October. The third will run in February. The range of polyethylenes is growing every day. Some types have an immediate place in the film pictures; others do not. This article analyzes the nomenclature of the polyethylenes and shows the relationship between melt indices, molecular weight, density, and other factors to the selection of a material for a film and to the type of processing involved. See "When you want polyethylene, know what you want—Part 2," p. 98.

A quick survey of the new plastics resins. A great deal of technical material has been published on each of the new resins and combinations thereof, but not before has a lay-level discussion of them been put in one place. This feature, by a well-known consultant, shows the present position and future possibilities of resins recently introduced and soon to have an impact in the market. See "Quick survey of new resins," p. 103.

Polyethylene cartridges for a new pistol. For years it has been an ambition of plastics people to invade the ammunition market. From Europe came shotgun shells of ethyl cellulose; from naval research in the U. S. came howitzer shells of ABS plastics. Now high-density polyethylene invades the field and in doing so became involved in new cartridge shell design and new pistol design. The remarkable story begins on p. 95.

What hope for the rigid vinyls? Is a breakthrough in processing and application of American rigid vinyls imminent? If so, where and how are they likely to be used? Can they now take over markets that they were expected to invade two or three years ago? Here is a discussion of the whole present picture with some application ideas which many readers will want to consider. See "Rigid vinyl—present and future," p. 106.

How to grow flowers in foam. Rigid urethane foam plus hydroponic chemicals in flats are used to raise "flower beds" to full growth for use in window displays, commercial buildings, churches, etc. The fact that the flowers are alive and thriving and the fact that the base foam may be re-used makes this an important innovation. See "Carpet of flowers," p. 105.

Programs of two important conferences. The Annual Technical Conference of S.P.E. will be held at the Commodore Hotel, New York City, January 27-30, 1959. Program begins on p. 128. The Annual Technical and Business Conference of the Reinforced Plastics Division of S.P.I. will be held at the Edgewater Beach Hotel in Chicago, February 3, 4, 5, 1959. Program begins on p. 173.

Rigid foams in the building field. Here speaks the man who was engineering consultant on the Monsanto "House of the Future" and on the use of plastics in the U. S. Pavilion at the Brussels World's Fair. Here is a discussion of all kinds and forms of rigid foams and their application to construction. The curtain-wall, the factory-built panel, the on-the-job placement of insulation all offer new opportunities to plastics. See "Rigid plastics foams in building," p. 91.

Watch for... our new format. MODERN PLASTICS Magazine has been restyled in tune with the most modern typographical and presentation concepts, effective with the January 1959 issue. "Don't Miss . . ." is to be fused with the Contents page to form a spread. Editorial page will appear opposite the inside back cover. We will have new and exciting covers reflecting and supplementing important articles. Departments have been revamped to get more and later information to our readers . . . January is traditionally our annual review and outlook issue. In January will be reported the 8th National Plastics Exposition and the S.P.I. Conference which took place in Chicago. . . . February issue will broadly present the latest applications and methods connected with reinforced plastics. Lead article concerns a huge new and most automatic RP processing plant. The third article in our series on polyethylene, covering pipe and other extrusions, will be offered in February. Also a complete engineering coverage of the most recommended methods for processing polypropylene . . . March lead will be first of a series of three articles dealing with all phases of the urethanes . . . Watch our Contents pages beginning January.

MODERN PLASTICS
Volume 36
December 1958
Number 4

Custom molders at the crossroads

In a period of industrial integration, captivity, and mergers, the custom processor faces new problems. Here are some opinions on the subject

Over the past several years, the make-up of the plastics industry has been gradually changing. Some of the once rigid lines of demarcation between supplier, processor, and end-user have started to waver . . . and today there is considerable talk about horizontal and vertical integration . . . about "captive" vs. "non-captive" operations. The very economic structure of the plastics industry is in balance.

In an effort to point out a right direction for those now standing at the crossroads, the editors of MODERN PLASTICS have surveyed the opinions of some of our leading processors, suppliers, and end-users. This article, which deals only with the situation as it applies to custom injection and compression molders, summarizes those opinions. In subsequent articles we will treat with economic conditions in the fields of extrusion, thermoforming, and reinforced plastics processing.

Economic conditions

Like everyone else who felt the effects of the recent recession, the custom molder, too, has had his share of disappearing markets. Because of their short capital position, many custom molders discovered that they had not built up the kind of reserve that would enable them to weather a slow business period. Others found themselves hampered by huge overheads which had grown up during the lush years from 1950 to 1955, when dollar volume sales had risen by over 60 percent. The pricing structure of the industry—based on plants operating at 70 to 80% of capacity—started to deteriorate as custom molders sliced competitive bids in an effort to "keep the machines busy." And over all hung the specter—whether real or fancied—of the captive operation.

While these woes were largely the result of an immediate economic condition, and will doubtlessly lessen as demand rises, they have revealed some of the defects in the industry's structure and pointed up the pattern that is beginning to emerge. As such, they merit further investigation.

One of the prime factors bearing on the future of custom processing is the question of captive vs. non-captive operations. There is much to be said for each type. For every well-run, efficient, and profitable operation like Western Electric's captive plant in Indianapolis, Ind., one could

"Departmentalized custom molding organizations . . . will ultimately merge with other diversified specialists in their own departmentalized category under a central management . . . This will leave free the smaller custom molding job shop category to handle a more localized sales and service area."

***R. L. Davidson,** Vice-Pres. & Sls. Mgr., Kurz-Kasch, Inc.*

"Custom molders who continually show creative ability and supply services over and beyond that which is normally required by blueprint bidding are the most likely to be successful . . . A healthy molder must be a well diversified molder."

William R. McLain, Pres., Kusan, Inc.

cite an example similar to that of the large radio and electronics manufacturer who was forced to scuttle a 50-ton captive press because he could buy more economically on the outside.

End-users are, in fact, learning that both captive and custom plants have their respective advantages. As one material supplier summed it up: "Plastics people have much to learn from such older industries as steel, iron, copper, etc. These industries have gone through the phase of 'captive vs. non-captive' operations some years ago and have now settled down to a *reasonable equilibrium*." They have shown that it is possible for both of the operations to coexist.

Captive plant economics

The swing towards captive operations in recent years is unmistakable. And the trend shows every sign of gaining momentum. But—and it's an important *but*—problems relating to the type of product and the quantity involved are strongly defining the areas in which the captive molder can profitably operate:

1) Where the parts required are so intricate, wanted in such small quantities, or must be secured with such insufficient lead time that, although the custom molder could probably do the job cheaper than the captive plant, he would not be able to give them the proper service.

2) Where the company uses such an enormous number of plastics parts and where the materials selection and engineering techniques involved are so routine and repetitive that the end-user can profitably integrate a plastics production line into his over-all manufacturing operations. Shoe heels, telephone parts, camera reels, some automotive and appliance components, electrical switch plates, and similar products are examples.

The economics in favor of the captive operation can look mighty appealing, particularly when the nature of the product is such (minimum changes in color, shape, or design required) that automatic molding equipment can be used. Some captive compression shop operations with automatic presses are costed out as low as 80¢ an hour. In addition, the captive molder feels that his operation gives him considerably more control over scheduling, inspection, and quality.

Corporate mergers also seem a factor. One materials supplier interviewed even stated, "the trend toward captive production can be laid in a large part to the empire building tendency among large companies and *to lack of concrete proof that plastics needs can be met more cheaply by custom processors.*"

The custom operation

Many custom molders feel that when the captive operator moves out of the two areas described above, he is looking for trouble. "Captive plants," one said, "are kidding themselves if they can't keep equipment and personnel specializing in management of that particular division busy to the extent of 80% capacity on three shifts a day, five days a week. If they keep machines busy on one shift for a few days, they are going to find the costs of 'hidden' overhead and the amortization and depreciation of capital assets running mighty high."

The particular fear of the custom molder seems to be that the end-user will be oversold on the concept of the captive operation and that once he sets it up, he will be reluctant to reverse himself. It is very easy, they feel, for a cost rationalization shell to encase the end-user and shield him from a decision to go back to custom operations.

Custom molders have marshalled some pretty impressive arguments on their own behalf.

1) The versatility of brainpower and equipment offered by a custom molder would require at least a 10- or 15-press captive plant running 80% of capacity to equal.

2) The custom molder can offer a full range of services, including product development, an engineering staff, tool design, quality control, production control, purchasing, etc. Several custom molders felt that rather than improving quality in switching to a captive operation, the quality suffered—once the captive plant found

"A medium sized custom molder, capable of producing parts in accordance with present day requirements will always have an opportunity . . . Position can be strengthened by providing customers with the best possible parts and meeting in every way their full requirements, such as tolerances, deliveries, etc."

R. B. Gutsch, Pres., aaRBee Plastic Co.

"The custom processor has many services to ally with molding. Finishing, metallizing, plating, spraying, etc., can all be profitably associated with molding . . . Where overhead must be spread evenly to each specific job, a run that does not utilize its share of engineering burden cannot be competitively held."

***Milton S. Sheftel**, Pres., Reed Plastics Corp.*

itself unable to throw rejects back on the custom molders.

3) Custom molders have more diversified experience and maintain up-to-the-minute knowledge in engineering, equipment, materials, etc., that cannot be duplicated by the captive plant. The more narrowly specialized and slow-moving captive plants, in fact, recognize this weakness when they farm out the more difficult jobs to someone else.

4) In custom plants, a good deal of down time can be salvaged by switching to other molds, taking on new orders, etc.

5) There is a possibility that once the captive plant has made its investment in space, equipment, personnel, etc., a style or design change may completely obsolete the part being contemplated and wipe out a good share of the investment.

Consolidating positions

While these considerations seem to insure the custom processor a good share of future business, he is moving still further to strengthen and consolidate his position.

First, in most of the jobs custom people are taking on, they are placing emphasis on engineering know-how, on the use of cleverly designed and intricate molds, and on the adaptation of new materials and new processing techniques.

Second, they are reorganizing with an eye on diversification. The molder who today does all his business in one field or who services only a small handful of end-users is practically inviting these customers to come in and investigate the feasibility of setting up their own captive plants. Custom molders cannot sit back any longer and wait for a benevolent materials supplier to develop a market for them. They are going to have to go out and develop their own.

Third, many custom molders are starting to tie in assembly, finishing, decorating, and other facilities to their molding operation, both to provide customers with a more finished product and to restore price levels to yield a better return.

Fourth, there is an industry-wide awakening to the need for a sensible pricing structure. For quite a while, the plastics industry has had no standard system of cost accounting on which to base prices and this year, with sharp competitive bidding so prevalent, price quotes have ranged all over the lot—in one known case with a 68% variation in prices quoted on a single plastic piece. Many molders have had their share of problems as a result.

Just how long this situation will last is difficult to judge. Profit margins for the custom molder have already shrunk to somewhere around 2%—and *he is going to have to take a stand somewhere*. As demand is now starting to rise to capacity, purchasing agents claim to notice a considerable tightening up in the range of price quotes. Custom molders also point to the fact that many of their major customers are at last recognizing the fact that reputable companies who operate at a reasonable profit are those that operate on a sound basis of quality, not by cost cutting, quality reducing gimmicks.

Finally, several of the custom molders interviewed in the course of this survey felt that the future for the custom molder lies in his "investing his profits in a proprietary line of products which would ultimately account for at least 50% of gross sales." The theory behind this is that a profitable operation must utilize all avail-

"Molding business is now experiencing applications of such materials as linear polyethylene, polypropylene, etc. . . . Research and product development on new applications using these materials should give the custom molder a new spurt."

***Dale Amos**, Pres., Amos-Thompson Corp.*

"Pricing structure in molding end of business will stabilize as 1) demand rises to capacity and 2) manufacturers realize that reputable companies who seek reasonable profit in operation are those that operate on a sound basis of quality."

George K. Scribner, Boonton Molding Co.

able machine time. Proprietary products can be run at the time of your own decision, instead of that of your customer.

While the majority of molders interviewed seemed to back this philosophy, several entered a cautionary note. They point out that most custom processors are not equipped with manpower, research and development facilities, or assembly equipment to handle this type of work without an increase in overhead. In addition, the average custom molder does not have the sales organization to successfully sell this type of merchandise. Where the proprietary item is strictly a molded part, the high cost of tooling to produce a varied line of proprietary items is a major factor that cannot be ignored.

Future patterns

From all these moves and counter-moves on the part of various segments of the plastics industry, a definite pattern seems to be emerging.

Vertical integration of captive plants is taking place among some of the larger users of molded plastics.

A move toward consolidation among custom molders is pointing to larger, more balanced firms. Eventually, we will see a few big custom molders who have applied the techniques of professional management to their operations.

One custom molder advanced a particularly sound critique on this second phenomena. "Today's custom molders seem to break down into two basic groups: 1) the larger departmentalized organizations which may specialize in one or two fields of plastics processing, which maintains an engineering staff, an inplant and outplant sales organization, accounting branch, a production control system, estimating, etc.; and 2) the smaller custom processor who also specializes in one or two phases of plastics processing but who operates more as a one-man organization.

"The economics of the first group are such that it can, in times of recession, shrink its overhead down only to a certain point beyond which it dare not go. The second group of smaller molders, however, can pull their heads in to a limitless degree, even shutting the plant down for a while until conditions improve.

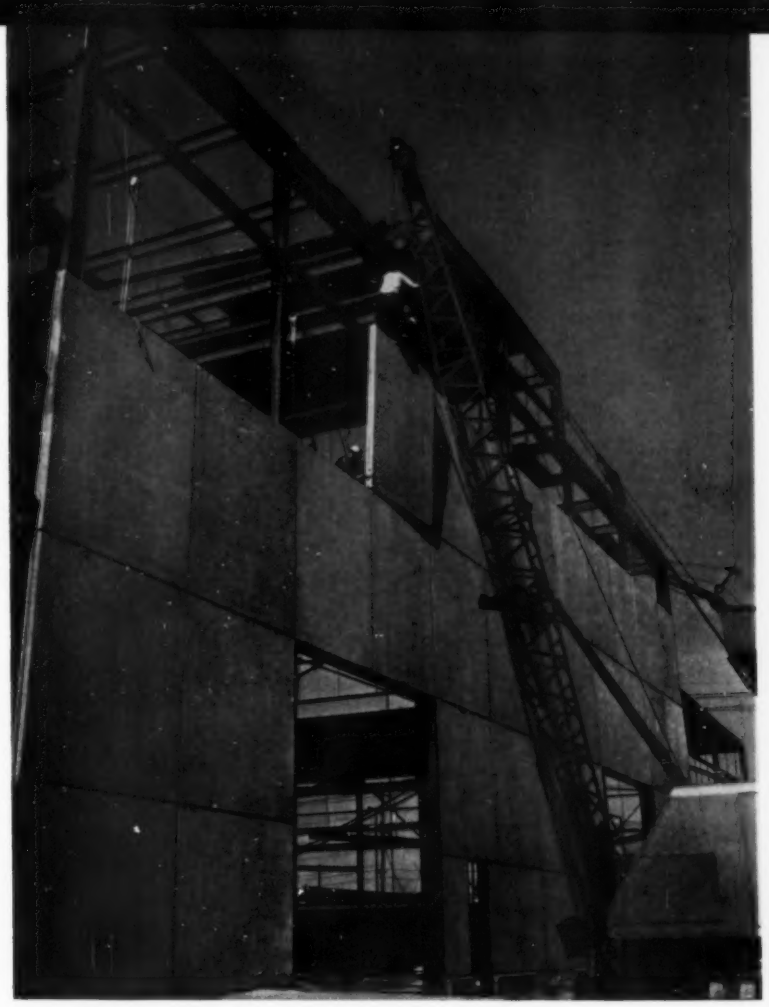
"It seems logical then to expect that the first group must ultimately merge with other diversified specialists under a central management to be financially large enough to obtain required capital on the open market and to be able to take advantage of calling on its diversified branch plant specialized know-how to blanket the field. This large plant will also be able to tackle large programmed custom operations, government contracts, and to invest in proprietary lines."

This consolidation, of course, does not imply the end of the smaller molders. This group too shows every signs of growing. The keynote of molding is still artistry and ingenuity and until such artistry can be mass-produced, it is unlikely that a "huge" operation will completely supplant the owner-operated custom molder. What seems more likely is that the smaller molders will develop into job shops able to handle a more localized sales and service area. They too, however, will have to adopt the modern tools and management techniques associated with the larger companies.

The advent of new materials and new processing equipment is also expected to have considerable bearing on the future of the custom molder—large and small. The custom molders are still "the shock troops of the industry" and everyone—both materials suppliers and end-users—looks to them and their diversified experience and know-how for the development work that must precede the widespread use of any new material. Similarly, plastics processing equipment is expected to change radically in type and design—faster presses, more compact, easier to operate, etc. Chances are that the custom molders will be in on the ground floor with much of this (*To page* 186)

"Certain captive operations show economies where parent company is very large, quantity demand for part is tremendous, and engineering somewhat routine and repetitive. On the other hand, custom prices are generally less than captive, custom molders have broader experience, more up-to-the minute know-how, custom operations can salvage down time by switching jobs; and custom molders have the flexibility to meet changing needs."

John J. Bachner, Pres., Chicago Molded Products Corp.



Curtain wall construction using sandwich panels with reinforced concrete facings 1½ to 1¾ in. thick and cores of 1½-in. styrene foam. Panels are up to 20 ft. long. (Photo, Dow Chemical Co.)

Rigid plastics foams in building

Cost and property factors give expanded plastics a firm competitive position. Current building trends foreshadow increased usage

*By Albert G. H. Dietz**

In many ways rigid plastics foams fit in with the major current trends in the building industry.

Perhaps the most pronounced trend is the shift from site fabrication to shop fabrication. Every effort is made to reduce the amount of site labor and site time involved in the erection of buildings and to transfer the operations as much as possible to the shop.

The second trend is in the direction of light construction with open plans and flexibility of arrangement of space. This calls for lightweight materials not only easily handled in the first place but in many instances capable of rearrangement as the functions carried on within the building change from time to time. This leads naturally to the use of components of which panels of various types are the most conspicuous example. Most of these panels incorporate some kind of core material and consequently present an attractive opportunity for the use of plastics foams.

Of the numerous types of rigid cellular plas-

*Professor of Building Engineering and Director of Plastics Research Laboratory, Massachusetts Institute of Technology, Cambridge, Mass. This article is based on a paper presented at the 1958 Annual S.P.I. Conference, Nov. 17-21, 1958, Chicago, Ill.

Fig. 1: Cavity wall construction consists of 4-in. face brick and 4-in. cinder block with 2 in. of styrene foam in cavity. (Photo, Dow)

tics—acetate, epoxy, phenolic, polyethylene, polystyrene, PVC, silicone, urea, and urethanes—the polystyrene and the urethane types are today the most active contenders for this market, with phenolics showing some good potentialities. Any of the other materials might come strongly into the picture if such present limitations as cost, high density, susceptibility to moisture, or other impediments which now limit some of the other plastics foams are overcome.

Polystyrene foam has had the longest, most widespread history of use in buildings. Its widest application today is in the form of pre-foamed "logs" cut into slabs, boards, or simple tailored shapes such as curved sections to fit around piping or curved walls of tanks. More recently expandable polystyrene beads have appeared. These have been developed for foaming in place and are particularly suited to complex shapes. They have the advantage of little or no

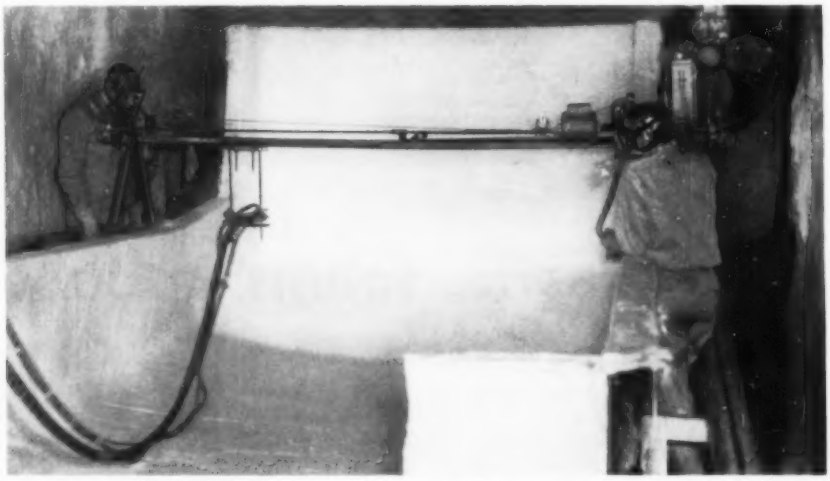


Fig. 2: Spraying polyurethane foam against inner surface of reinforced plastics shell used in Monsanto's "House of the Future"

Fig. 3: Foaming polyurethane mix is poured onto plywood sheet as first step in making structural sandwich with foamed-in-place core. (Photo, National Aniline Div.)

waste. A still more recent development is the combination of expandable polystyrene beads with epoxy resin. When these are mixed, the epoxy gives off heat as it cures and thereby causes the beads to expand at the same time that the epoxy bonds them firmly together into a stronger and more rigid block than is possible with the beads alone. If the expansion takes place against a surfacing material such as the skin of a sandwich, the epoxy at the same time bonds to the skin. An outside source of heat such as steam is unnecessary.

Urethane foams are produced by a reaction between a diisocyanate and a polyol such as a polyester or a polyether. They are commonly employed as "one-shot" and as "pre-mix" combinations. In the one-shot, all the ingredients are mixed at one time whereas in the pre-mix some ingredients are mixed ahead of time and the final mixing takes place just before use. The one-shot approach is best used in the shop where better mixing equipment and controls are available than in the field, where the pre-mix approach is more suitable.

Phenolics, like the urethanes, can either be prefoamed or foamed in place. Recent developments indicate that the phenolics can be made to rise in high and narrow spaces found between studs in house construction.

Relative advantages

Of the three types, the phenolics are the most attractive from the standpoint of cost but, in the densities most useful for building, tend to be brittle and relatively weak Acid catalysts may make them corrosive to metals in the presence of moisture. Polystyrene is intermediate in cost between phenolic and urethane for a given density. All three are higher in cost than some of the competitive materials already in use in the building field, but in the 2 lb./cu. ft.-density generally suggested for building applications, the costs are not out of line, provided other advantages can be obtained. Polystyrene foam has adequate structural strength for most building applications and good resistance to water. Its relatively low heat distortion point limits its high-temperature application, but for most building uses the heat distortion point is adequate. A further shortcoming is lack of resistance to burning, but self-extinguishing varieties are now available. The urethane foams, because of the wide variety of possible reactants, are quite versatile and can be given all degrees of rigidity. They can be given good structural strength and low

Fig. 4: Workman places three hollow steel panels in half of wooden mold, which will later be clamped together with another half and then conveyed to dispensing machine that automatically fills the panels with foam

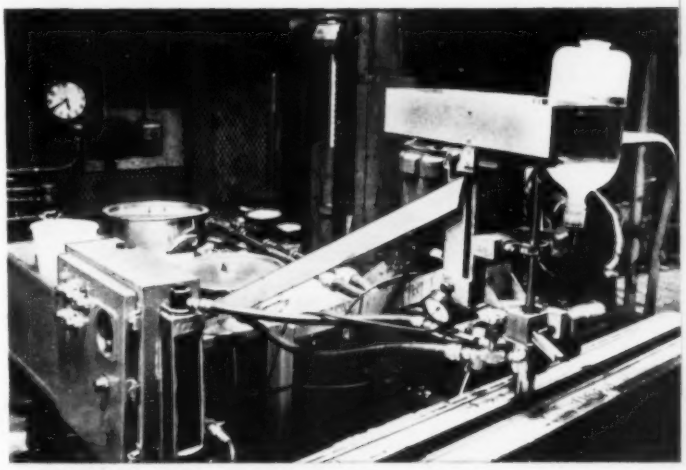


Fig. 5: Nozzle has been inserted in open slot along top of wooden mold and into small hole in metal panel inside mold. The two containers with steel lids at left hold ingredients of urethane foam. Inverted white bottle in foreground contains solvent for cleaning nozzle of machine

Fig. 6: Edge view of filled panel. Pencil points to hole where foam was poured to fill cavity. Panels were made for U. S. Steel Homes. (Photos, Nopco Chemical)

Table I: Comparative costs[a]

	Material cost	
Expanded plastics	*$/lb.*	*$/bd. ft.*
Phenolic	0.30-0.60	0.08[b]
Polystyrene	0.25-0.45	0.10[c]
Urethane	0.75-1.25	0.16[b]
Nonplastic types		
Insulations		
Fill type (fibers and granular)		0.02-0.05
Batt and blankets (fibers, organic and inorganic)		0.02-0.08
Boards (foamed glass, cork, fiber)		0.05-0.18
Cores—structural		
Paper honeycomb		0.05-0.15
Wood slats		0.03-0.08
Paper cylinders		0.02-0.05
Foamed glass		0.12-0.14

[a]R. N. Kennedy and W. C. Goggin, "Plastics Foams: Future Trends and Markets," Commercial Chemical Development Association, 1958

[b]At 2 lb./cu. ft.

[c]Pre-expanded board 1.5-2.0 lb./cu. ft.

thermal conductivity. Large volume sections may be molded in relatively simple molds. They require suitable, though simple, mixing equipment and proper precautions in the use of the isocyanates which are toxic, although the finished foam products are not.

Principal uses of rigid cellular plastics in building today are as thermal insulation. Their coefficient of heat transmission is quite low compared with other materials such as mineral wools and cork. Those foams, such as pre-expanded styrene, which are unicellular and have low moisture absorption, can act as their own barriers against the transmission of moisture.

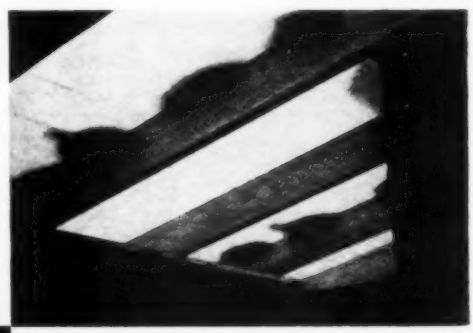
Several recent building installations are shown in the accompanying photographs. In the applications shown in Figs. 1 and 2, p. 92, the foamed plastic plays no significant structural role. It is insulation or combined insulation and vapor barrier. Strength need only be great enough to withstand handling and to support small loads.

In sandwich construction the story is different. In a structural sandwich two hard strong faces are securely bonded to a relatively lightweight core to provide a slab whose geometry is such as to provide strength and stiffness combined with lightness.

Many plastics foams can meet these requirements at moderate densities. The density required depends on the loads, but even at 2 lb./cu. ft. the mechanical properties are good enough for many sandwich panels.

In Fig. 3, p. 92, a sheet of plywood has been placed in the bottom of a jig and freshly-mixed polyurethane is being poured on top of the plywood. A second sheet of plywood is immediately dropped into place above it and the jig is closed. As the polyurethane foams it expands, filling the space between the plywood facings and, as it cures and hardens, bonds to the plywood.

In another method of making sandwich panels the facings are pre-assembled in the form of a hollow panel and are (*To page* 187)



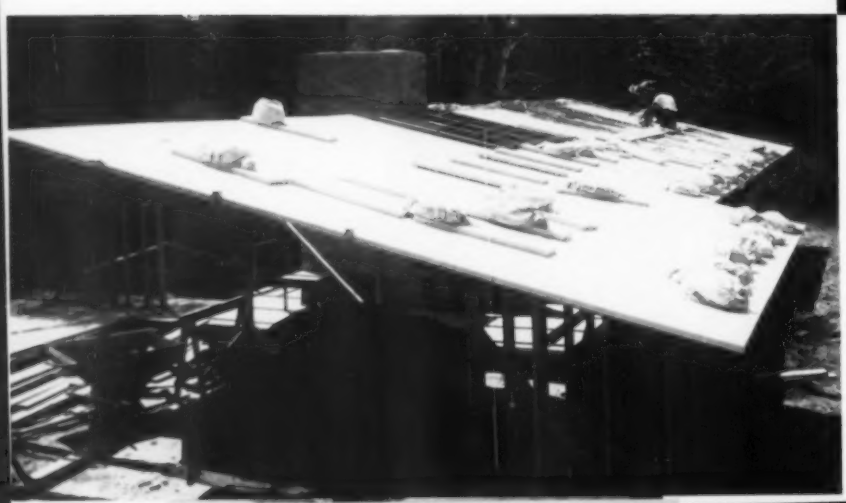
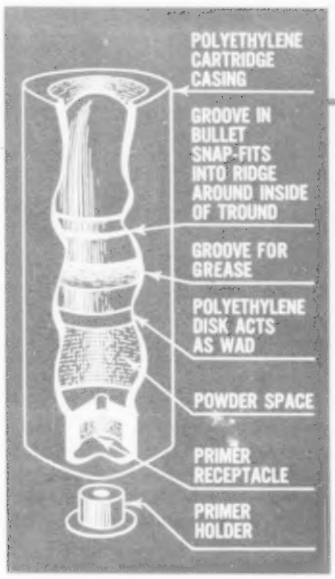


Fig. 7 (left): Sandwich roof panels for house. Faces are reinforced polyester, cores styrene foam

Fig. 8 (above): Polyester-styrene foam sandwich panels on cut-out portion of roof of house shown in Fig. 7. Faces and cores are sufficiently translucent to admit diffused light. Note outline of sandbags used on roof to hold panels in place while adhesive cures. (Photos, Dow)



Handful of new polyethylene 0.38-cal. "trounds" (above) and the 15-shot, open-chamber pistol for which they were designed. At right: diagram of pistol cylinder and magazine (11-shot model), showing nesting and feed-through of trounds. At left: details of 0.38-cal. tround, which uses standard bullet, primer, and powder

Polyethylene cartridges

Injection molded linear polyethylene cartridge cases of a unique triangular shape (see photograph, above) are a vital part of a radically new pistol that combines the best features of the conventional automatics and revolvers with some advantages of its own. Pistols and cartridges are produced by Dardick Corp., New York, N. Y.

The new "automatic revolver" uses an open or split chamber (see right, above). The cartridge loads laterally from the magazine and is ejected sideways after firing, eliminating the reciprocating action found with conventional hand guns. This action is responsible for most of the jamming in automatics and for the relatively slow rate of fire in revolvers. With the new cartridge there is a gain in magazine capacity and speed of reloading. One model fires 20 rounds without reloading. The feeding and ejection mechanisms are extremely simple, making the pistol jam-proof.

The success of this split chamber design depends on the cartridge construction. Whereas round metal cartridges invariably split lengthwise in open chambers, the heavy, rounded corners of the triangular "trounds" successfully contain the pressure.

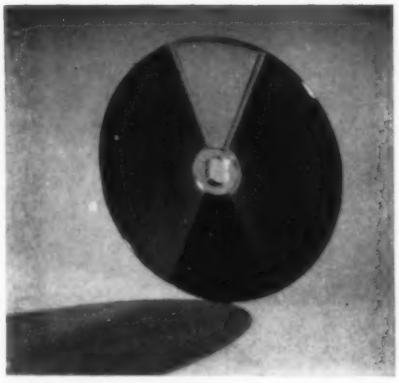
How the case was developed

In developing the new cartridge case, aluminum was tried first. Then the inventor learned of the success of ABS polymer in 105-mm. howitzer shells (see "ABS joins the artillery," MPL, Feb. 1958, p. 96), and machined some test cartridges from that plastic. The preliminary results with this material, which promised considerable savings in cost and weight over aluminum, were so encouraging that a mold was made. Then began a program of molding casings of all the common thermoplastics, trying them in the action of the gun, and test-firing them.

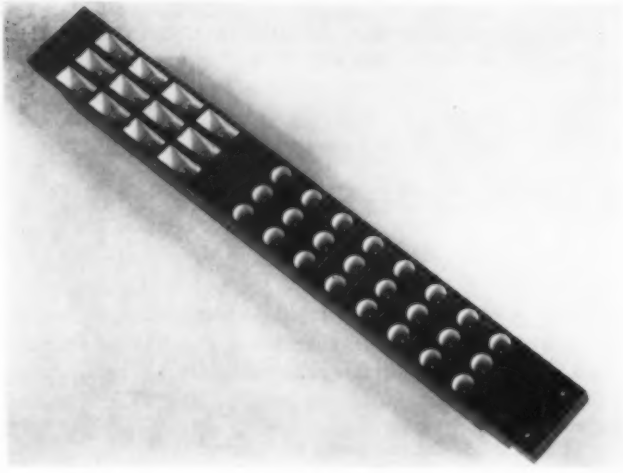
High-density polyethylene (Celanese Fortiflex) was the final choice. Its resilience, chemical resistance, low water absorption, colorability, economy, and moldability, (*To page* 192)

FIRST POLYCARBONATE

Announced in the United States about one year ago and only now being turned out in quantity from a semi-works plant, polycarbonate resin is already making several successful appearances on the industrial scene. Transparent, heat resistant, and tough, the unusual properties of the material suggest many possible uses. On these pages are shown nine of the first commercial applications which have opened up for General Electric's Lexan polycarbonate resin. The applications range from small molded coil forms to intricate 10½ in.-long terminal blocks for electronic equipment. Why the material was chosen for these particular applications is explained in the captions accompanying the illustrations.



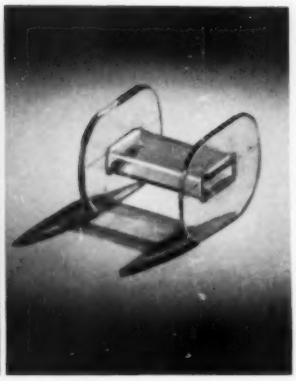
TRANSPARENCY: For control disk with four painted color sections, polycarbonate resin offers transparency coupled with heat resistance. In this application, the disk required optical material that could be used at operating temperature of 240° F. Disk is molded by The Grigoleit Co., Decatur, Ill.; lacquer paints supplied by Logo Div., Bee Chemical Co., Chicago, Ill.



HEAT RESISTANCE: Lampholder terminal block with molded-in holes is used inside electronic unit where heat generated cannot be readily dissipated. As replacement for another thermoplastic that melted under the heat, polycarbonate with its high heat resistance and good dimensional stability at high temperatures successfully solved critical problem. The block is molded by Booker & Wallestad, Minneapolis, Minn., for Remington Rand Univac, Div. of Sperry Rand Corp., St. Paul, Minn.

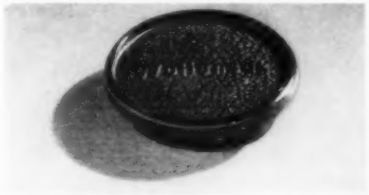
DIMENSIONAL STABILITY: Business machine part requires molding to close tolerances and minimum dimensional changes in service. To satisfy requirement, molded polycarbonate card guides, which show excellent dimensional stability under varying moisture conditions and at elevated temperatures, were used. Polycarbonate's self-extinguishing characteristics also met company specifications. Guide is molded by Consolidated Molded Products Corp., Scranton, Pa., for International Business Machines Corp., Endicott, N. Y.

APPLICATIONS

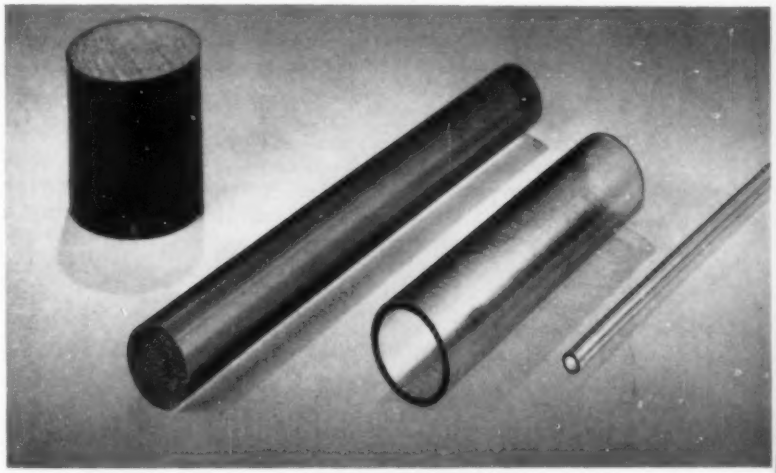


OXIDATION RESISTANCE: Coil forms must withstand temperatures above 200° F. without deforming under stress of tightly wound coil. Since polycarbonate has a heat distortion temperature of 280 to 290° F. under load, resists oxidation at high temperatures, is non-corrosive, and has generally good electrical properties, it is ideally suited for the application. One coil form (left) was molded for Sigma Instruments, Inc., South Braintree, Mass., by Waterbury Cos., Inc., Waterbury, Conn.; the other (right) was molded for Simpson Electric Co., Chicago, Ill., by Joliet Plastics, Inc., Joliet, Ill.

IMPACT RESISTANCE: High impact strength, good insulation properties, and good color and gloss characteristics determined use of polycarbonate resin for molded elbow prod connector. The connector is used on electrical instruments. Connector is molded by Joliet Plastics, Inc., Joliet, Ill., for Simpson Electric Co., Chicago, Ill.



CREEP AND RECOVERY: Camera lens cap must maintain a firm fit over expensive optical lenses even under prolonged exposure at high temperatures and high humidity. The excellent creep properties exhibited by polycarbonate resin showed it to be superior to other materials that were tested for the application. Lens cap is molded by General Electric Co., Decatur, Ill., for Revere Camera Co., Chicago, Ill.



WEAR PROPERTIES: In order for camera to function properly, circular cam must maintain its dimensions within very close tolerances—a requirement that encouraged manufacturers to take advantage of polycarbonate's dimensional stability and wear properties. Cam is molded by Quinn-Berry Corp., Erie, Pa., for Argus Cameras, Ann Arbor, Mich.

PROCESSABILITY. Polycarbonate resin can be easily extruded into tubing, pipe, sheet, rods, films, etc.—all offering the same good physicals as the molded pieces. Because of the good machinability of the resin, industrial components can easily be fabricated from the extrusions. Polycarbonate rod, plate, tubing, and other extruded shapes are available from Polymer Corp., Reading, Pa.

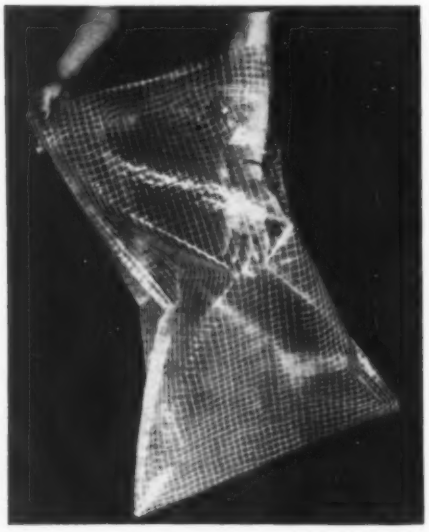
When you want polyethylene,

Second in a series of articles relating resin properties to process and end use requirements. Covered are film and coatings. The first article, published in the October issue, dealt with molding materials and bottles

Film-grade resin will probably account for about 35% of all the polyethylene (PE) consumed in the U. S. in 1958. No matter how much other uses may grow, the use of film seems to increase at a greater rate than any other group of applications. And as volume increases so does resin variety. When a new use for PE film is announced today, it is likely that a new formulation is employed.

This situation will probably intensify until the market for PE film is saturated—and that time is many years away. In the early 1950's, when Union Carbide Plastics Co. (formerly Bakelite) and Du Pont were the only PE producers, a resin of around 0.917 density and a melt index (MI) of 2 was by far the most commonly used, not only for film but for other applications as well. A similar grade is now manufactured by other producers, and it is still commonly used for film. The market for this film consists of bags, tarps, camel back, balloons, and construction uses. It is still expanding, but growth is leveling out somewhat since the material has been around in quantity for five or six years and has been thoroughly evaluated. The new trend is toward other markets, such as garment bags and wrappers, where a moderate increase in density and MI are desirable. It is in these new markets that PE film may have its greatest growth in the next five to 10 years. Many of these markets, however, are yet to be penetrated.

Broadened fields of application are expected to result from the development of fibrous glass-reinforced PE film. (Photo, Lamex, Inc., and Owens-Corning Fiberglas)



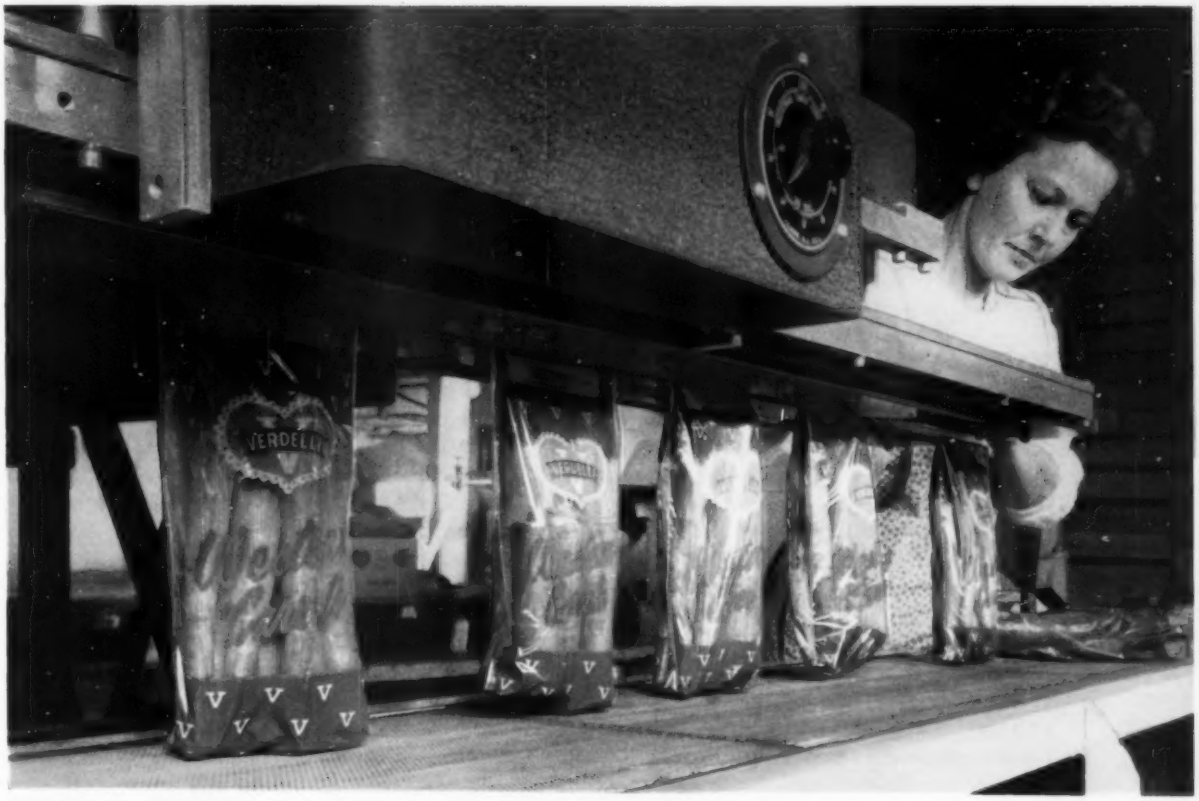
One estimator states that all flexible PE film has grown at an average rate of 26% a year for the last five years, and he expects the next five years to show an average rate of growth of at least 14% a year.

Medium-density conventional PE (0.926 to 0.940) is expected to play a large part in cornering a good portion of this market, although only limited quantities of anything over 0.930 have been used to date.

Low-pressure-processed, high-density (0.941 to 0.960) linear PE, such as the Ziegler or Phillips type, is just beginning to move in the film field. Suitable markets have not yet been developed. At this writing its price of 43¢/lb. compared to 35¢ for low-density and 37 to 42¢ for medium-density has perhaps held it back. In addition it needs different handling during the film-forming operation. Processors have apparently been so busy turning out conventional film that they haven't had much time to experiment with the high-density resins. In addition it seems ticketed for other markets than those now generally served by low-density PE.

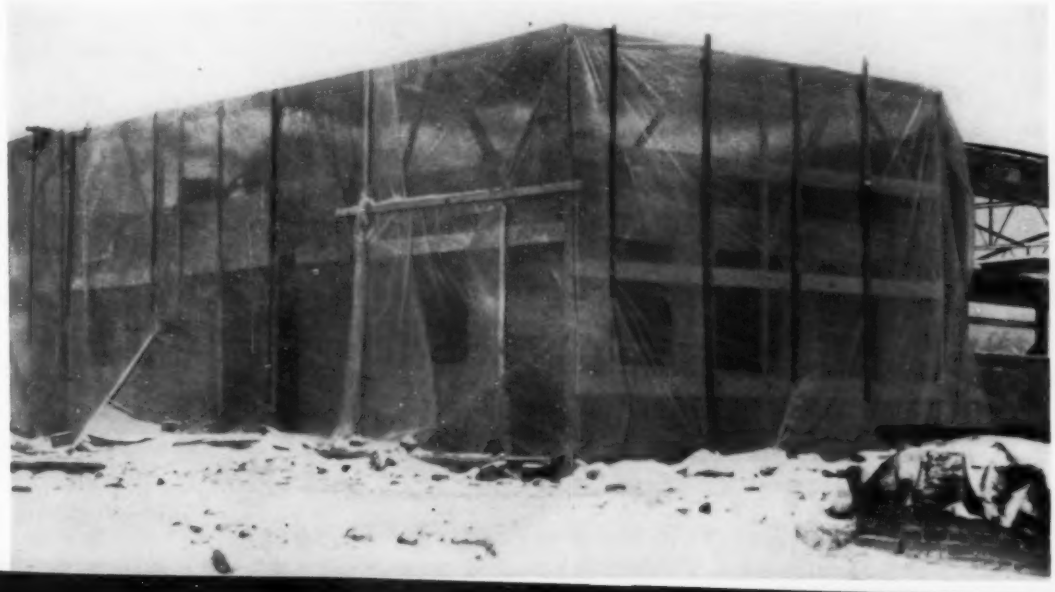
Conventional polyethylene film has several remarkable properties. It is extremely tough,

know what you want – Part 2



Handled on standard machinery, polyethylene film has a firmly established market in fresh vegetable bags. (Photos, Union Carbide Plastics Co.)

Shields of polyethylene film make it now feasible for building construction work to proceed under practically all weather conditions



In bleachery operations, polyethylene film makes effective skid covers (above). Other uses include bleaching vat covers, temperature barriers, etc. (Photo, Koppers Co., Inc.)

is comparatively easy to process, has several degrees of transparency, and is low in cost. However, there has been a constant effort to improve clarity and add a little stiffness. The earlier films were somewhat milky and too limp for easy handling in wrapping machines. (Stiffness is really a misnomer since PE in thin gages is always flexible, but when the trade uses the term it means stiffness in comparison to cellophane.) However, the property of "stiffness" in conventional polyethylene for wrappers may be overplayed, according to one producer. He states that good wrapper material for some articles has been made from 0.920 density PE and feels there isn't enough difference between 0.920 and 0.930 density to be important. On the other hand, he points out that a more important consideration is the difficulty of heat sealing under tension. And the heat sealing problems invariably increase as the density of the material goes up.

Nonetheless there is a general feeling in the trade that the slight differences in density of conventional PE between 0.917 and 0.930 are important factors in obtaining suitable clarity and stiffness. Attempts to improve these properties in conventional polyethylene have been marked by use of resin with higher densities and variations in the extrusion process. A general rule of thumb for the conventional material would be: as density goes up so does clarity and stiffness. At the lowest extreme would be a 0.914 density resin by Du Pont to produce a shrinkable film which is almost like rubber. The highest so far publicized in conventional PE is the experimental Spencer-Crown Zellerbach bread wrapper which is thought to be around 0.932, a density deemed necessary because it gave the desired clarity for see-through and stiffness for ease in handling on the machine.

Variety of resins available

An examination of one resin producer's list of materials quickly shows this variation in the use of resin for film. A resin with a density of 0.921 with an MI of 3.4 is offered for premium packaging—it gives high transparency and gloss and good impact strength. A 0.923 density with an MI of 2.1 is suggested for stiffness, transparency, and low permeability. When the melt index is raised to 4, this same density resin is offered for extrusion coating to give adhesion and a high draw rate. Then there is a jump to a density of 0.926 and an MI of 12 for soft goods and garment bags that gives clarity, gloss, draw-down to thin gages. Finally there is a 0.930 material with an MI of 3 that gives *very high* stiffness, higher heat distortion, and lower permeability. In most of these examples a variation is offered if more slip is needed.

Other producers' lists will vary somewhat from the above, and the purchaser must remember that there are differences between resins of the same MI from different producers. This is because MI does not differentiate between resins of different molecular weight distributions, so that resins of identical MI may process differently. It should also be pointed out that the MI of one density or type of PE cannot be compared directly with the MI of a PE of another density.

In general most of the older films made from conventional PE have a melt index of around 2 or 3 which means that they have a fairly high viscosity and will produce a tough film. This viscosity is more important for film than for molded pieces where MI often goes up to as high as 20 or 25 or even 50 in order to obtain fast flow. When a film with extra good draw is needed the MI generally used is 4 or more—which results in perhaps a slight sacrifice in toughness.

The MI used will, of course, depend on the

Resin density and MI related to two properties of polyethylene film					
Density	0.960	0.950	0.940	9.930	0.920
Melt Index	0.9	1.2	1.4	1.7	2.0
Stiffness, p.s.i.	140,000	110,000	60,000	40,000	20,000
Impact, ft.-lb./in. of notch	3	4	8	12	20

density, but most producers give a choice of several MI's, with each density offered for film grade resin. Thus, one producer offers several grades of 0.917 density with an MI of 2 and also offers the same density with an MI of 4. The latter has better slip and is thus less likely to block or stick on the wind-up. In a 0.925 density resin, he offers an MI of 4 and another of 8. The latter has the same properties but will run faster. Speed, of course, is highly important but in order to gain speed the film producer must sacrifice other properties, such as toughness, that he would obtain from a lower-density resin with a lower MI. In general, a higher melt index means better transparency and faster flow, but toughness and other desirable properties have to be sacrificed.

Toughness has come to be almost a trademark associated with polyethylene, but there are varying degrees of that property. The films in the 0.917 to 0.923 density range are the toughest. Their toughness implies an impact strength that will hold something like 20 lb. of apples or more without bursting. One authority says they are so tough that if used for a gum wrapper a man would have to train a pet beaver to open the wrapper for him. But as density of conventional polyethylene resin goes up that kind of toughness or impact strength goes down—a bag dropped under load may burst. Thus film grade resins with a density of 0.920 have made their mark in the bag, tarp and other fields where toughness is essential.

But there are many applications where toughness is not so critical. Flat wrapping for textiles, such as sheets or men's shirts, are ex-

Garment bags of thin-gage polyethylene film have been enthusiastically received by dry cleaners and their customers. (Photo, U. S. Industrial Chemicals Co.)

amples. In this case clarity is desirable and the higher density adds that property.

Perhaps the greatest volume breakaway from the conventional lower density films was the film for garment bags. Film for this purpose has decreased in thickness ever since the application became practical. Producers generally advertise resins with a density of around 0.925 and an MI of 4 or 5 for this job. U. S. I. and Union Carbide Plastics Co. offer a density of 0.929 and an MI of 5 from which 0.35-mil film can be produced, although most films for this purpose are now 0.40 or 0.45 mil. There is no consistency in use of resin for this very thin gage—for example another producer offers a 0.926 density with MI of 12. It is offered for extruders who are equipped to run extra fast.

Medium- and high-density PE

Medium-density resin of the high-pressure-processed type in the range of from 0.930 to 0.940 is still a small factor in the film field, but the bread wrapper mentioned earlier may be a harbinger of a whole host of applications for automatic wrapping. It costs 2 to 7¢/lb. more than lower densities because manufacturing costs go up when density rises to 0.930. Some producers have a 0.929 density material that sells for 35¢ and is claimed to be practically equal to the 0.930 in its properties. These higher density conventional PE films are asserted to have better clarity and more stiffness. Producers think it may be the answer to a more satisfactory wrapping material; some of them feel that it will eventually have a larger volume than lower-density film because of the immense potentiality in such things as bread wrappers, cigarette packages, and similar applications.

Coating of polyethylene on paper gives grease resistance, moisture barrier, heat-sealability. (Photo, Union Carbide Plastics Co.)

High-density or linear polyethylene films made from resins over 0.940 are still in the developmental stage. Most processors are now agreed that slot-die extrusion is better fitted than blown extrusion for producing such film and that they must be handled differently than lower-density, conventional type polyethylene. However, there are still some producers who have not yet given up on blow-extrusion. At any rate high-density films are, of course, more stiff than low-density material and producers claim that thinner films can often be used to replace low-density film. For example, a 1- or 2-mil film in high density can be used to replace a 2- or 4-mil film for highway curing applications.

Something to remember about high-density linear polyethylene is that oft repeated statement that toughness declines as density goes up and, consequently, applications must be carefully chosen. And, strangely enough, clarity may be somewhat better in a lower density linear film, such as 0.945 or 0.950 than in a 0.960 film, provided both are quenched to the same degree, which is the reverse of conventional PE where clarity improves as density goes up. In linear PE it is difficult to obtain clarity with high burst strength, but the film is strong enough for overwraps. The clarity problem will probably be conquered by adoption of quenched film extrusion but the burst strength situation is problematical.

An interesting table by Phillips, which gives the results of its tests for various resin densities in relation to two important properties, appears on p. 101. Unfortunately, test methods of various companies are variable, especially stiffness tests, but at least this table gives a general idea.

Built-in tear tape

An exciting claim for possibilities of linear polyethylene was made by N. S. Hewitt of the Flexible Packaging Div. of Continental Can Co. at the last Packaging Show, when he told that wrappers made from Phillips (*To page* 194)

Quick survey of new resins

*By J. Harry DuBois**

The plastics industry has, within the past two years, witnessed a remarkable number of important new advances in materials development—advances with explosive market implications. We here present a quick view of the new materials picture shaping up today.

This article by J. H. DuBois, based on a paper delivered at the 1958 New England S.P.I. Conference, brings together in one place the latest in plastics materials progress. It points to some of the more important advances in plastics materials and attempts to place them in the proper perspective.

Since most of these materials have already been covered in considerable detail in previous issues of MODERN PLASTICS and the MODERN PLASTICS *Encyclopedia Issue*, a reference guide is printed on p. 210 for those readers seeking review or who wish more detailed information.

Many plastics materials announced some time ago are still "new" to the molders and end-users. The original announcements are often so far in advance of production that they are overlooked or treated casually later on when the resins should be evaluated carefully and *sold* to provide new products for the future. Since the most successful custom processors are those who pioneer each new material, this survey includes those compounds that can be promoted now for future business, as well as some of the very latest products which are not yet ready for the sales program.

Boron compounds

The University of Southern California and Stauffer Chemical Co. are working on some semi-organic polymers based on boron and phosphorous to make available truly high-temperature plastic materials. Some of these compounds are reported as stable up to 900° F. The development work is being done for the Bureau of Ships and the Air Force.

Acetal resin

Polyoxymethylene, or acetal resin, is expected to have a very large future after its stability against aging, chemical combinations, and depolymerization is proved to be up to its anticipated performance. This resin (*Delrin*, E. I. du Pont de Nemours & Co., Inc.) is a high-strength material that will have numerous applications in the mechanical components field where it is expected to replace many of the metals. Electrical properties will be satisfactory for most applications. New markets may include aerosol containers, engine and generator bearings, gears, portable electric drill housings, carburetors, car window cranks and hardware.

Fluorocarbons

A fluorocarbon resin that can be molded and extruded with conventional equipment (*Teflon FEP* fluorocarbon resin, E. I. du Pont de Nemours & Co., Inc.) is one of the more important new technical materials. It has the desirable properties generally associated with polytetrafluoroethylene but with an operating temperature limit of approximately 450° F.—50° lower than that of TFE resin. It can be combined with various inorganic fillers to gain rigidity and dimensional control, with minimum reduction in its excellent electrical properties. Unlike poly TFE, it is a true thermoplastic, and is molded at a melt temperature of 750° F. into molds held at 400° F. Injection or transfer-type molds can be used.

One of the most interesting of the new materials consists of ceramic fibers, 50% silica and 50% alumina, coated with polytetrafluoroethylene (TFE) (*Teflon*, E. I. du Pont de Nemours & Co., Inc.) by the beater-addition process and then molded into a homogenous sheet (*Duroid 5650*, Rogers Corp.). This unique material has solved one serious missile problem: the ceramic fiber slows the ablation rate to half of pure TFE, leaving a smooth, carbon-free surface. Other formulations of the TFE resin-coated ceramic fibers are giving excellent

*See page 104.

performance as chemical and thermal gaskets where high flange pressures eliminate use of unfilled TFE resin. Many applications are found in the new hydraulic and oil circuits.

A new filled TFE (*Fluorosint*, The Polymer Corp.) is designed for minimum expansion, better dimensional control, reduced creep, and minimum deformation under load.

A coating which consists of a mixture of phenolic and TFE resin has been introduced (Acheson Colloids Co.). It may be applied by brush or spray to plastics and other heat-sensitive materials, as well as aluminum, rubber, and wood. On heat cure, the coating becomes a firmly bonded, tough film that provides the low friction and good release properties of tetrafluoroethylene at the corrosion resistance level of phenolics.

Glass microspheres

Hollow boro-silicate glass microspheres (Emerson & Cuming, Inc.) are now available. The material, which looks like fine sand, is intended for use as a lightweight, free flowing low-conductivity filler. It is suitable as a filler in low-loss dielectric materials. The material is expected to open new markets in the radome, heat barrier, foam, and potting field.

Chlorinated polyether

A high-molecular-weight chlorinated polyether thermoplastic (*Penton*, Hercules Powder Co.) exhibits a high degree of abrasion resistance, excellent dimensional stability due mostly to almost zero moisture pickup, and an ease of fabrication that make it competitive with many metals in the corrosion equipment fields. It may be applied by several processes as a coating material. The newly developed markets for the material include proximity fuse front cases, valve linings, pipe, precision gears, protective coatings, tanks, and similar applications.

Polypropylene

Polypropylene is a heat-resistant, hard, glossy, chemically inert and lightweight (0.90 specific gravity) moldable and extrudable polyolefin. Like polyethylene in many respects, it will compete in certain markets with that resin and also with the cellulosics, vinyls, styrene and nylon. No mass change-overs to polypropylene are expected although substantial markets have already been established in the housewares field. It has a higher heat-distortion point than its polyethylene cousins, but also becomes brittle in milder cold than does PE.

The markets now being developed include automotive and electrical components, textile fibers, pipe, valves, fittings, films, etc. Thermoformable polypropylene sheet materials are used for making tote boxes, luggage, housings, tanks, etc.

Polyethylene

The several polyethylenes have been separated by ASTM D-20 into the following three types:

Type I: 0.910-0.925 g. /cc.—Low Density
Type II: 0.926-0.940 g. /cc.—Medium Density
Type III: 0.941-0.965 g. /cc.—High Density

Excellent and stable markets are being established in fibers, blown and injection-molded containers, wire-coating, and pipe. Automotive gains are noted in leaf spring inserts, pillar post covers, horns, seat cover fabrics, kick pads, etc. In general, the high density polyethylene products are creating their own new markets based on their very desirable physical and chemical properties—such as stiffness, boilability, and stress cracking resistance. Numerous products such as detergents, which could not be packaged in regular polyethylene, are handled well in high-density polyethylene bottles. Thinner walls can be used—resulting in weight and material savings.

A whole field of copolymers (*To page* 205)

The author

J. Harry DuBois is a member of S.P.I. and a Plastics Pioneer. He maintains active membership in Institute of Radio Engineers, American Institute of Electrical Engineers, American Society of Mechanical Engineers, and the Plastics Institute (London). He is an honorary Life Member and past president of S.P.E., graduated from the University of Minnesota in Electrical Engineering and has been in the plastics industry since 1927. His experience includes sales management and engineering assignments for General Electric Co., Shaw Insulator Co., Plax Corp., Mycalex Corp. of America, and Synthetic Mica Co. He is presently serving the plastics industry as an engineer and sales consultant.

Carpet of flowers

Slabs of urethane foam serve as seed-beds. Seeding is done directly on foam and roots grow through foam into sub-medium. No weeds interfere with growth of plants. Fully grown flower carpet (right) can be cut in strips for floats or other displays. (Photo, Allied Chemical Corp.)

Urethane foam provides a method for soil-less growing of flowers for commercial displays—keeps down weeds in home gardens

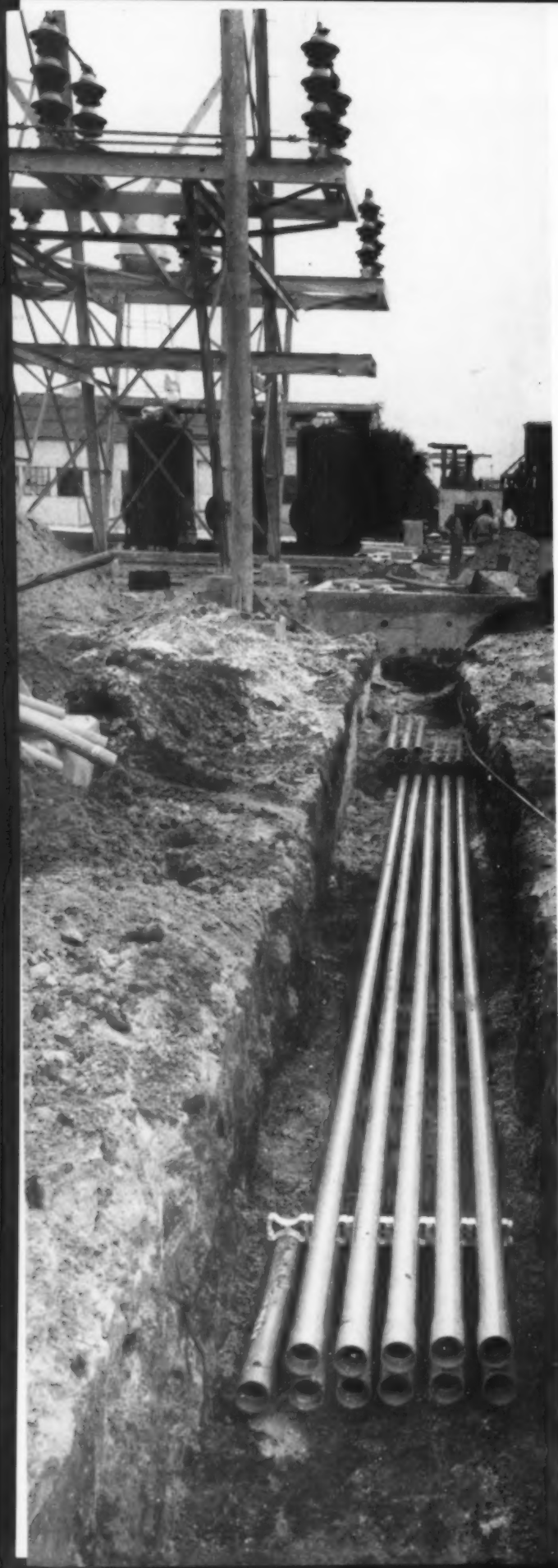
Blooming flower beds in vivid colors, which can be sold by the yard, the foot, or in special designs for floral decorative purposes, are now possible by seeding directly on polyether urethane foam.

In starting the flower carpets, the foam is cut to size and shape, then placed on an inert sub-medium consisting of fine gravel and vermiculite. Upon germination, the roots penetrate through the fine cells of the foam. During this period, the material is kept moist. When the seeds germinate and the first leaves appear, formulated liquid nutrients are applied.

Researchers at the Los Angeles State and County Arboretum, Arcadia, Calif., working under the direction of Drs. Frits W. Went and William S. Stewart, found a $\frac{5}{8}$-in. thickness of the flexible foam most practical for flower carpets. Thicker pieces do not permit roots of many species of plants to penetrate with ease, and would also hold too much liquid and thus become too heavy and awkward to handle for display purposes. Thinner pieces of foam may not be strong enough to hold together when lifted and moved, particularly when the carpets are large.

For planting directly into the garden, an area free of plants needs only be raked and watered to allow the roots to penetrate the soil. The urethane foam provides a ready made mulch which keeps the root zone cool and keeps soil moist for longer periods. Plantings set out in this fashion remain weed-free for long periods, because weed seeds already in the soil will only rarely penetrate up through the foam, and seeds blowing in seldom survive in the well-established plant community.

These floral carpets may be used for floats, displays in large convention or exhibition halls, or as a convenient and rapid means of setting up outdoor displays of bedding plants. Home gardeners could enjoy the relative ease of simply lifting into place a carpet of pre-started, properly spaced bedding plants, or young plants of the annual cutflower type. Dwarf varieties and low growing bedding plants are particularly suitable for growing by this soil-less technique.—END



RIGID VINYL—

Production and consumption of rigid (unplasticized) vinyl in the United States, while not as high as in some other parts of the world, (see "Japan's place in plastics," MPL, Oct. 1958, p. 109) have shown strong year-to-year growth. The total use of rigid vinyl pipe and sheeting was estimated at about 25 million lb. in 1957. Of this amount, pipe and profile extrusions were consuming rigid PVC compounds at an annual rate of 10 million lb.; 13 to 15 million lb. of sheeting were predominantly calendered vinyl copolymers, which are quite different materials from unplasticized PVC and will be discussed later in this article.

We may reasonably estimate a 60 to 70 million lb. annual consumption rate of rigid unplasticized polyvinyl chloride resin by the middle 1960's.

Among our more important commercial rigid vinyl compounds today are Geon[1] 8700A and 8750, furnished in the form of cubes of small uniform size. They consist essentially of a polyvinyl chloride homopolymer of high molecular weight, suitably compounded with stabilizer, lubricant, and pigment.

They sell for 42½¢/lb.

Compound 8700A is a high-impact extrusion material (Type II). It is used in applications where unusual shock resistance is required.

Compound 8750 is a normal impact (Type I) formulation. It is principally a high-molecular-weight PVC resin compounded to the minimum extent necessary to secure good processing, with added lubricant, stabilizer, and the necessary pigment. It has an impact value of less than 1 ft./lb. It has very high chemical resistance and thus is favored as a material for making components for processing plants where chemicals must be handled. It is possible that a moderate improvement of impact resistance

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[1]Geon is a trademark of B. F. Goodrich Chemical Co.

Underground conduit extruded of rigid vinyl will not corrode, has smooth interior which facilitates pulling wires now and in years to come

PRESENT AND FUTURE

Consumption of unplasticized PVC is expected to go to a 70-million lb./year rate by the mid-60's. Improved resins, more applications are in prospect

By George A. Fowles and William E. Manring†*

in normal-impact material would result in its becoming a much more important factor in the rigid vinyl market.

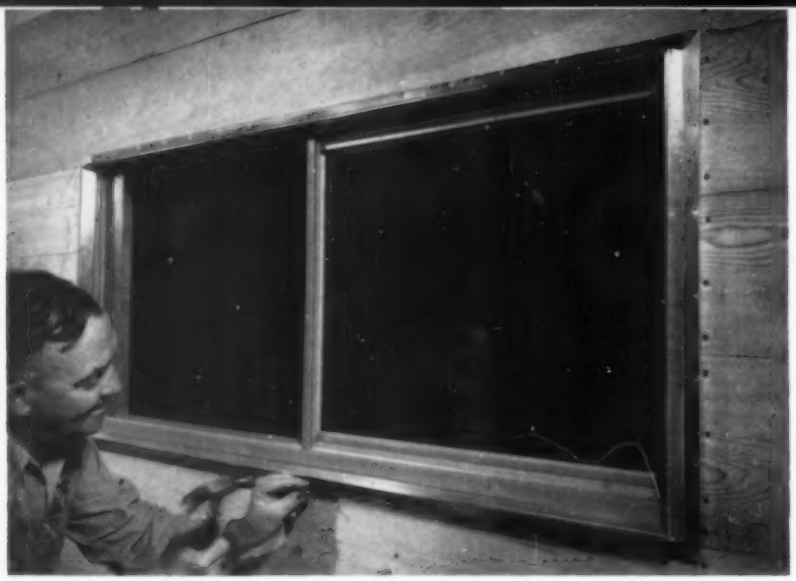
What are the market potentials?

Today the market for Geon rigid vinyl is about evenly divided between these two compounds. The normal-impact material, in the form of pipe and sheet, goes principally into the eastern market for processing industries such as paper, brewing, vinegar, and chemical, while the western market uses the high-impact type for oil field, gas, and water piping, and other similar applications.

The largest application for rigid vinyl pipe is expected to be in the petroleum and gas fields, although chemical and water service are probably larger applications at present. About a half million lb. per year was used for petroleum and gas in 1957 and 1958, and its use is gaining momentum at a rate which indicates that from 6 to 8 million lb. will be used in 1962, with an increasing rate of gain in the five years after that. Rigid vinyl pipe is useful for petroleum and gas service under conditions such as in corrosive soil which attacks metal pipe and where paraffin accumulation on pipe walls is a problem. Such pipe is best used at pressures under 75 p.s.i. and where pressure surges are not encountered.

In the oil fields, thermoplastic pipe is used for disposal of brine, as well as for crude oil transmission. Rigid vinyl pipe is in service in several Midwest fields for these uses. The vinyl is used because it is immune to galvanic corrosion and highly resistant to both salt water and sour crude oil. Vinyl is rather new in the petroleum field compared with other plastics. It is probable that several types of thermoplastic pipe will contend for this market with service at lowest cost as the determining factor; vinyl will certainly be a candidate for that distinction. There is reason to believe that cost factors will also make vinyl more competitive with other types of pipe used in oil and gas operations when more extensive aging data become

Industrial air conditioning baffles for moisture elimination are formed in saw-tooth shape from rigid vinyl sheet



Window frames (above), as well as sash and frames for storm doors and windows, are among the latest production applications of rigid vinyl profile extrusions

available and when the petroleum industry learns more about its possibilities.

A public utility company has installed some 15,000 ft. of rigid vinyl pipe during the past two years in 2-p.s.i. gas service lines. This installation has been closely watched and found satisfactory. It is expected that its success will result in large-scale usage of rigid vinyl by this company for such service lines beginning in 1959. Part of the pipe has been pulled through metal lines which have failed; the remainder has been buried direct. Results of both methods have been good.

Economies through PVC pipe

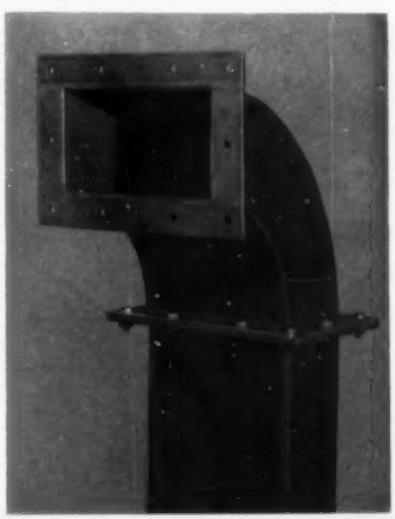
Favorable cost information is continuing to accumulate. For example, a comparative cost table by the Tucson Gas Electric Light & Power Co. shows that a 13,260-ft. installation of 2-in. vinyl pipe cost $6714 compared with $9301 for steel pipe. Report by the National Association of Corrosion Engineers indicates that the average cost to install extruded plastic is slightly less than cement asbestos in the 3- and 4-in. sizes and considerably less than steel in the 2- to 4-in. range.

Irrigation and water service is now thought to account for from 15 to 20% of all rigid vinyl pipe produced. By 1962, it is estimated that somewhere around 7 million lb. will be used for water with a steady growth for some time thereafter. More than half of the vinyl pipe sold in California today is for water transmission lines.

In an avocado grove near Santa Paula, Calif., rigid vinyl pipe is used in a 15-mile irrigation

Bubble packages vacuum formed of rigid vinyl sheet are attractive and have exceptional clarity. Forming cycles are short; hence production rates are high

Duct work, fabricated by welding formed sheets of rigid vinyl, has high strength, is corrosion resistant and easily cleaned



system. The pipe is buried in continuously moist soil. Metal pipe has given only a short service life under these conditions. The pipe corroded rapidly and internal rust and scaling clogged the sprinkler jets.

PVC in water supply

A big boom in the use of rigid PVC cold water pipe in Florida hotel swimming pools is going on right now. They are converting from metal to PVC because the latter is not corroded by salt water. One hotel has even converted its air conditioning water lines to PVC not only because of water corrosion, but also in order to save weight on top of the building in lead pipes from the tank to the distribution system. A Florida utility has put in PVC pipe in its water system. In fact, utility companies in various parts of the country are installing rigid PVC where they have to bring in their water supply from distant sources.

More than 25,000 ft. of high-impact rigid PVC pipe is being used in public parks and sports centers in San Antonio, Texas. These underground sprinkling systems were built around PVC pipe for anti-corrosion and economy of installation.

The classic example of rigid polyvinyl chloride pipe vs. metal pipe was the Navy's installation of pipe on shipboard to wash down the ship with sea water following an atomic exposure. (See "Shower-bath for warships," MPL, Oct. 1956, p. 129.)

Another variation in pipe is an extruded rigid vinyl liner 0.065 in. thick which is used inside steel pipe. This job is intended to prevent corrosion in high-pressure and high-temperature applications. The potential savings in maintenance that can be made from this combination is a big enough factor to consider a future in millions of feet.

Up to now, this article has been devoted almost entirely to pipe, since most of the activity with rigid PVC extrusion has been in that field. But there is a possibility that profile extrusions will eventually account for more poundage than will pipe. An estimated 2 million lb./year of rigid PVC was used for extruded shapes or profiles in 1957-1958. From 6 to 8 million lb. could be used for profiles five years from now, especially if the use in window tracks and frames grows as expected. If such things as vinyl siding and gutters take hold, the future would be enormous.

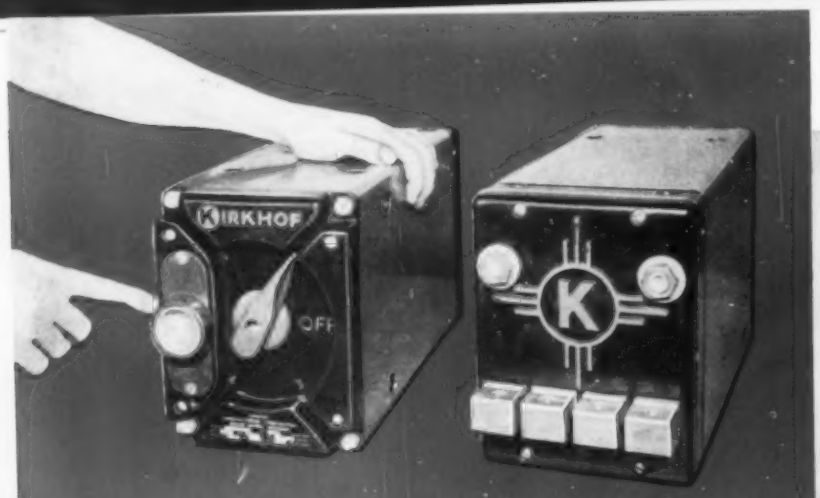
Several things could happen to multiply potential volume in this "shapes" market for such things as gutters, channeling, window frames, and the like. Resin improvement resulting in easier processability and higher temperature resistance would also be a great stimulus.

Producers recognize that resins with better heat and sunlight resistance are desirable, and they are moving in that direction. The day has long passed when a producer can sit on his hands and be satisfied with that day's production or feel that the maximum for heat resistance, as an example, of vinyl resin has been reached. Competition just won't permit existence of a satisfied producer.

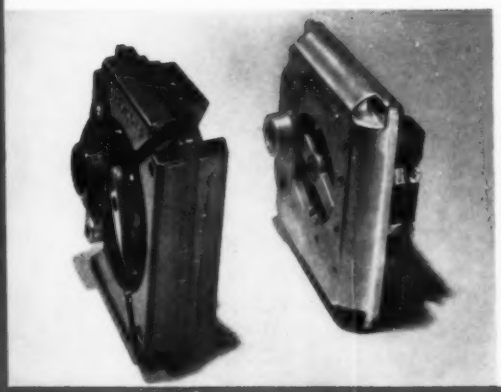
But processors and merchandisers, too, must look for markets—it isn't enough to produce the finest extrusion ever made—it has to be sold. If it fails in application, the reason why must be found and corrected. Imagination and ingenuity must be used to find markets—not only as a replacement for some- (*To page* 211)

Light-weight luggage can be formed to pleasing shapes from rigid vinyl sheet in a variety of colors and patterns. The material is strong and long wearing

Profile extrusions of rigid vinyl have unlimited size and shape range. Annual consumption for such uses is estimated at 8 million lb. five years from now



Molded parts at ends of welding transformer, showing drain channels molded into tap switch cover (left)



Fully enclosed tap switch (left), replaces open aluminum unit (right)

Premix scores in welding transformers

First shortproof unit is developed at no increase in cost through the use of reinforced polyester molding compound

*By Preston E. Girton**

Switching from die cast aluminum to molded reinforced polyester premix enabled Kirkhof Mfg. Corp., Grand Rapids, Mich., to effect major improvement on several models of its transformer line at no increase in cost. Involved are the firm's 50-, 60-, and 70-KVA resistance-welding transformers.

Welding transformers have long been subject to a troublesome service problem: dirt, moisture, and other plant contaminants work their way into the interior and provide a conductive path that may often lead to shorts.

By redesigning the structural parts in molded premix, this problem is completely eliminated: 1) Since the plastic parts are electrically nonconductive, they isolate all current-carrying members from ground; 2) the good flow characteristics and mechanical strength of the molding compound permit production of precisely-fitting mating parts for sealed construction. Thus, no contaminants can get inside the transformer.

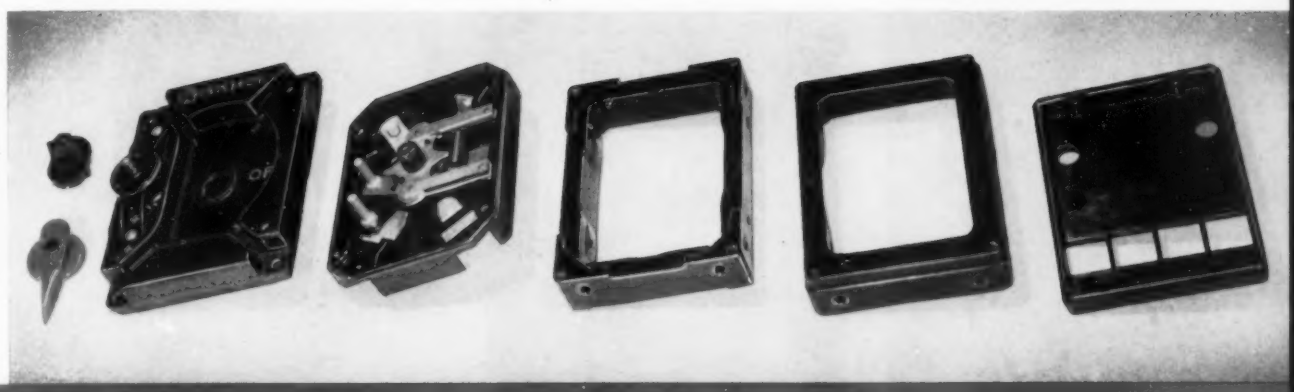
The extensive use of molded polyester parts has also reduced finishing and other operations to a point where these basic improvements were obtained without increasing the unit manufacturing cost.

Other mechanical and electrical design improvements resulted in increasing the thermal capacity by 90% and current output by 136% with no increase in the overall size of the unit, compared with the original high-flux-density packaged units developed by Kirkhof.

Service experience with the new transform-

In premix molding of transformer part, operator places weighed charge in mold

* Chief Development Engineer, Kirkhof Mfg. Corp.

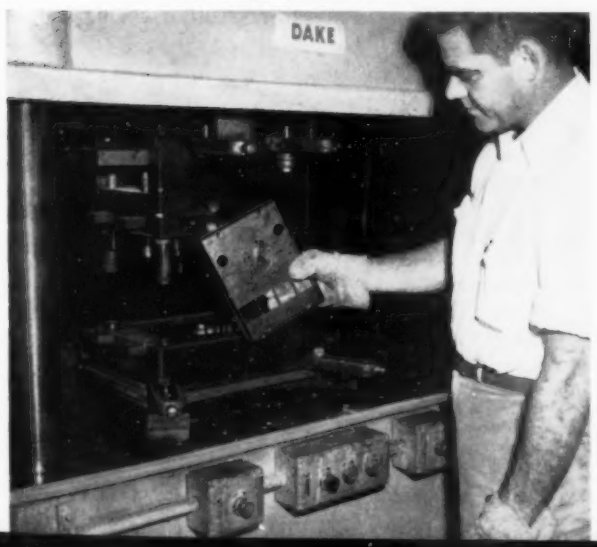


Molded components of transformer housing include, left to right: switch handle and plug; tap switch cover; tap switch base; rear body molding; front body molding; front cover

ers has been uniformly good. An analysis of maintenance records for transformers used by a major body plant in the automotive industry showed an annual repair rate of less than 1% from all causes for the molded polyester models. After two years, only 17 of 2166 units in service—of which 13 were damaged by physical abuse or improper operation—had been returned for repair. The same study, reviewing three years' service experience with 11,809 earlier models, revealed an annual repair rate from all causes of 6 and 13% a year, depending on the model. This substantial reduction in service failures can be directly translated into such tangible benefits as less interruption of production, a smaller inventory of spares, and lower operating and maintenance costs.

The major structural elements of the transformer consist of a fully-enclosed tap switch, a pair of rectangular body moldings which are located at the front and rear ends of the primary-secondary assembly, a housing which encloses the assembly, and a cover plate which closes off the front end of the unit. Except for the front cover, which is fastened separately to the front body molding, the entire transformer is held together by four longitudinal tie rods which extend between the outer face of the tap switch cover and front body casting. All structural parts are molded from Thermaflow 100, an electrical-grade fibrous glass-reinforced polyester molding compound manufactured by Atlas Powder Co., Wilmington, Del. The only non-plastic part is the housing for the primary-secondary assembly. This is formed from sheet steel and insulated on both surfaces with Corvel cellulosic fusion-bonded finishing material manufactured by National Polymer Products, Inc., Reading, Pa.

Finished front cover molding (see extreme right in photo above) is removed from mold



Redesigned switch superior

Development of a fully enclosed tap switch was an important step in eliminating shorts due to external contamination. In the previous design the switch was assembled on a cast aluminum cover which permitted dirt and moisture to work past the rim and short out the primary through the cover. The sealed construction which overcomes this problem is made up of the following five molded parts: base, cover, switch drive shaft, switch handle, and plug cover.

The ability to mold-in many structural details eliminated several machining and assembly steps. Assembly time for the redesigned switch has been reduced by two-thirds as a result. Four stationary contacts are installed in recessed bosses molded into (*To page* 215)

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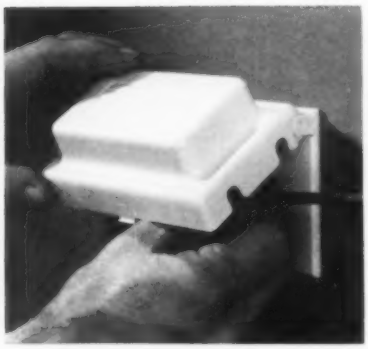

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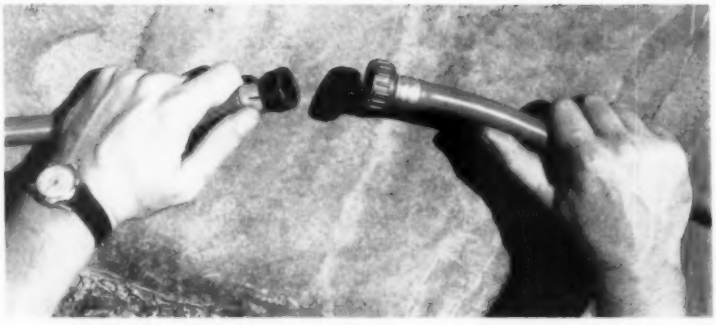

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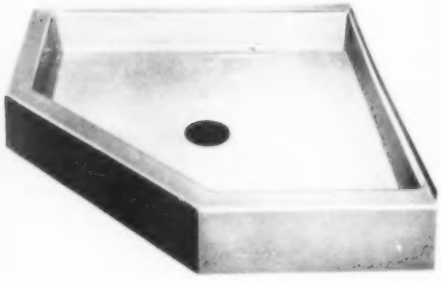

PLASTICS

1 Drinking cup designed for children features a built-in straw. Molded of high-density polyethylene, the cup will take rugged abuse from small fry and will withstand boiling water. The units come in red, blue, and yellow, and are designed to nest when not in use. Capacity is eight ounces. Manufactured by Sippit Cups, Inc., Brooklyn, N. Y., of Celanese's Fortiflex.

2 Shower stall water receptor of reinforced plastics is strong, durable, light, and inexpensive. Molded in one piece, the unit is seamless and requires no maintenance. Product of Loup Engineering Co., Columbus, Neb.; Pleogen polyester resins and gelcotes supplied by Mol-Rez Division of American Petrochemical Corp., Minneapolis, Minn.

3 Young children can be kept from tampering with electric outlets if acetate Safe-T-Plate covers are installed. The new product consists of a wall outlet cover to which a lid with a friction catch is attached. The lid is deep enough to cover standard male plugs inserted into the wall outlets. Molded of Eastman Tenite by National Fabricating Co., South Ozone Park, N. Y.; manufacturer is Plastic Development Corp., N. Y., N. Y.

4 Decorative Christmas wreaths molded of expandable polystyrene beads are available in 12-, 14-, and 24-in. diameter sizes. The wreaths are light and have good weather resistance. They are produced in plain white and 10 different color combinations. The cellular structure of the foam makes it easy to attach decorations with straight pins or wire stuck into the wreaths. Produced by H. S. Shaffer, Inc., Cincinnati, Ohio, of Dow's Pelaspan 8 expandable polystyrene beads.

5 Nylon coupler for garden hoses is said to outwear metal fittings four to one. In tests conducted by the manufacturer the coupler withstood 1000 stress cycles without leaking, while standard metal couplers during similar tests pulled off the hose at 250 cycles. Because of nylon's resiliency, the coupler is said to withstand being run over by a car, and to outlast metal when dragged over rough surfaces. Produced by W. D. Allen Mfg. Co., Chicago, Ill., of Du Pont Zytel resin.

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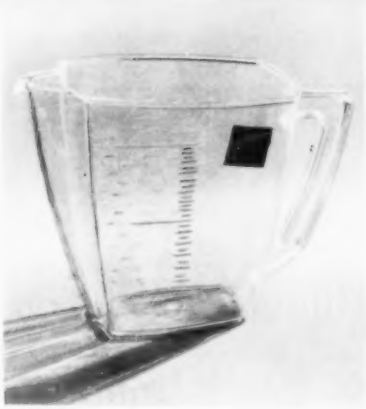

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PRODUCTS

6 Scaled down to size, a new toy housekeeping set includes a carpet sweeper, broom, mop, dustpan and sponge. All the parts of the set are designed to do an actual cleaning job. Molded of polyethylene in pastel colors, the cleaning tools are practically unbreakable, yet soft enough not to mar surfaces against which they are struck. Window in the sweeper is acetate. Set is manufactured by Kiddie Brush & Toy Co., Jonesville, Mich., of Eastman materials.

7 The latest thing in bicycle accessories is a speed indicator molded of acrylic. The device works by air pressure. When the bike is in motion, air enters a small opening on the dial and activates a small fan blade on the base of a spring-mounted needle. The faster the bike moves, the more the needle is deflected. The face of the indicator is molded of clear acrylic, while the back of the instrument is of bright red material. Manufactured by Sinko Mfg. & Tool Co., Chicago, Ill., Rohm & Haas' Plexiglas.

8 Here it is—a measuring pitcher that is both shatter-resistant and boilable. Molded of polymethylstyrene, the pitcher has a no-drip, hook-on pouring spout which fits over the edges of bowls and jars, eliminating the need for a funnel for pouring into small containers. The 32-oz. pitcher has molded graduations on the outside, giving measurements by the cup, ounce, cubic centimeter, pint, and quart. The 79¢ product is molded for Formulette Co., Inc., Jamaica, N. Y. by Boonton Molding Co., Boonton, N. J., of American Cyanamid's Cymac.

9 High-density polyethylene adds increased rigidity to the other advantages of polyethylene refuse cans—quiet, ease of cleaning, and integral color. A new can, molded by Dapol Plastics, Inc., Worcester, Mass., of Bakelite resin, has a non-scuff foot pedal and inner can of low-density polyethylene. The can bodies are molded at the rate of 75 an hour; lids and foot pedals at 90 per hour.

10 Folding door for bathtubs and stall showers is constructed of flexible, translucent polyethylene panels attached to aluminum sections. When open, it gives accessibility to more than 80% of the tub or shower area. Manufactured by Showerfold Door Corp., Detroit, Mich.

Plastics Engineering

Dr. James F. Carley, Engineering Editor

Progress in extrusion

The passing of extruder design from an art to a science has made the extruder probably the most versatile and productive machine available for processing plastics

By Ernest C. Bernhardt†

The plastics extruder of today is akin to, and has developed from, screw conveyors and screw pumps (see Fig. 1, below). Specifically, it evolved from the type that utilizes the viscosity of the liquid being pumped and its tendency to wet metal surfaces. When the screw of such a pump is rotated, one surface of the liquid is held back, or dragged, by the barrel. This drag tends to resist the rotation of the viscous liquid with the screw and causes it to move along the screw axis instead. Drag flow is the basis of modern extruder design, though it is recognized that other mechanisms also come into play particularly in the feed section, where powders rather than liquids are in motion.

Although screw extruders operating by drag flow were in use before 1900, the first important step in understanding their operation did not come until 1922. In that year, Rowell and Finlayson (1)[1] derived and tested the first equations describing the flow and pressure development in "screw viscosity pumps." In 1951, Pigott (2) presented similar equations and proposed a method of allowing for the effect of shear on viscosity. Strub (3) in 1952, Carley, Mallouk, and McKelvey (4) in 1953, and Maillefer (5) in 1954 concerned themselves with the specific application and extension of these equations for use with polymer melts. In 1956, Darnell and Mol derived equations describing the solids conveying of granular resins in the first flights of a plasticating extruder (6).

This does not mean that extrusion did not play an important part in our industry before then. The commercial application of screw extruders for compounding of thermoplastics and for producing extruded shapes dates back to the 1930's. However, these early machines were designed almost entirely on the basis of practical experience. The theory of extrusion, on the other hand, is relatively new, and extrusion as a branch of polymer processing has gained recognition as a science only approximately within the last 10 years.

Progress on two fronts

With this historical backdrop in mind, I shall attempt to analyze our current progress from two major viewpoints. They are: 1) the scientific and technological and 2) the commercial and industrial.

Perhaps the most significant earmark of the present state of extrusion is the growing use of engineering theory in the design

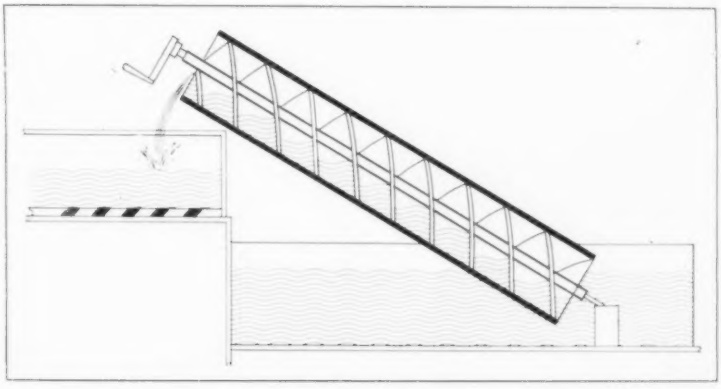


Fig. 1: Screw pump of the gravity type, reportedly invented by Archimedes around 250 B.C. Screw-flight and barrel turn together, trap water in submerged flight and roll it upwards

* Reg. U.S. Pat. Off.

† Polychemicals Dept., E. I. du Pont de Nemours and Co., Wilmington, Del.

Adapted from a talk given at the S.P.I. West Coast Conference in March, 1958.

[1] Numbers in parentheses link to references at end of article, p. 120.

and operation of equipment for commercial operations.

Until recently, most extrusion operations were small, technically simple, and required little investment. This made it economically feasible to carry them out on a very small scale. In the late 1930's extruder screws were about 2-in. in diameter, the machines processed about 30 lb. hr., and they represented an investment of not much over $4000. Under these circumstances, it was relatively simple and it involved practically no risk to develop and improve the equipment through empirical methods.

Since that time, however, the techniques and equipment have been refined and the applications have grown in volume to the point where much larger investments are involved. Commercial extruders 15-in. in diameter with 800-hp. drives and with capacities of 5000 lb. hr. have been built and are in operation. At present, these giants find application primarily as continuous compounders in the plants of resin producers.

The wire and cable industry uses machines as large as 8 and 10 in. in diameter that deliver about 800 lb. hr. Six- and eight-in.-diameter machines are being used for coating paper with polyethylene at extrusion rates as high as 850 lb. hr. (Fig. 2, below). Installations of this size may cost over $250,000.

A high percentage of all of the polymers used today is processed on equipment in this size range. Carrying out experimental development work on such large equipment is much too costly. In addition, without guiding theory, the scale-up of large machines from practical results on small ones is extremely risky. For these reasons, the practical value of a more theoretical approach in designing processing equipment is gaining widespread recognition among engineers in all branches of the industry. Nor is this awakening confined to extrusion: other branches of plastics processing, particularly injection molding and calendering, are also feeling its effects.

The continuing technological progress in extrusion is characterized and may be illustrated by several developments. The work recently published by Mohr, Saxton, and Jepson on the "Theory of mixing in the single screw extruder" (7) is an example. Their findings have made it possible to calculate the mixing performance of extruders, and to predict the interrelationships of mixing performance with output and power consumption. Another example is the work presented by Squires at the 1958 S.P.E. Technical Conference (8) describing a more refined method for calculating the performance of deep-flighted screws, and of screws with partly empty channels.

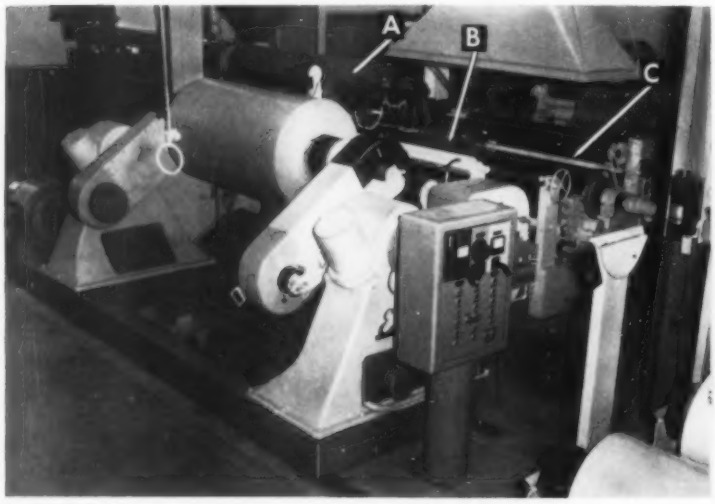


Fig. 2: A 72-in. polyethylene paper-coating line; A is the extruder barrel, B is the cross-head film die, C is the polished chill roll. (Photo: Frank W. Egan & Co.)

Instrumentation advances

Another area of rapid progress is instrumentation. The extrusion process is becoming more refined. As tolerances and specifications become narrower, it is natural that improved instruments are required to control the machines and to measure their performance. The stock thermocouples and pressure gages, which were developed in our laboratories to measure extruder performance, are widely used and well known (9). These instruments were the first commercially available devices for measuring the temperature and pressure of the *melt* issuing from the extruder screw. Heretofore, temperature measurements had been confined only to the metal body of the extruder, and no accurate pressure sensing devices were available.

No less important for the development of this industry are the new stepless controllers. These instruments control the temperature of the machine at the desired level through a gradual adjustment of voltage supplied to the heater bands. This improvement over "off-on" temperature control makes it possible to reduce temperature variation in the extruder barrel and the die body to a minimum. This results in a more even delivery of melt from the die lips at a more uniform temperature and die pressure. In the extrusion of film and of wire coverings and other precision operations these improved instruments can be of significant value.

Modern extruders are expected to be truly pulse-free pumps which deliver melt at a completely uniform and high rate as well as at an absolutely steady melt temperature, free of any temperature striations. These demands on screw design have resulted in a decided trend toward the acceptance of metering-type screws, which are characterized by several flights of uniform channel dimensions at the discharge end. These screws have given excellent uniformity of delivery, and lend themselves read-

ily to reliable performance calculations. The output of such a screw in relation to the die restriction is easily predictable and the amount of heat generated in the resin that is due to internal shearing can be calculated in advance (10).

Usually no more than three screws are required per machine to process all common thermoplastic materials through any ordinary die at efficient rates and with excellent uniformity. These screws will all have the same general configuration, and will differ from each other primarily in channel depth.

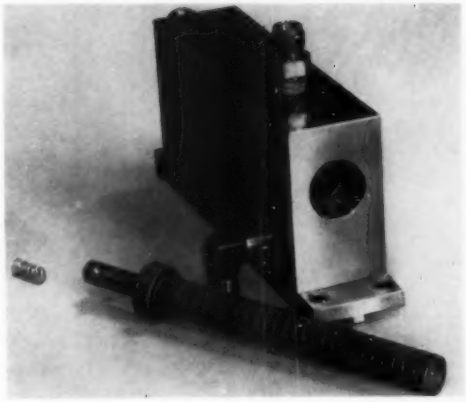


Fig. 3: This tiny "extruder" with TFE-coated screw is used to meter a chromic and sulfuric acid solution for continuous analysis of an organic chemical waste stream

Trend to longer barrels

Another concurrent development which has taken place to satisfy the same demand for extrusion free of pulses, and free of temperature inhomogeneities, has been the trend toward machines with much longer barrels. Whereas 10 years ago extruders commonly had barrel-length-to-barrel-diameter ratios of 12:1, very few machines are built today for work on plastic materials with ratios of less than 18:1; 20:1 and 24:1 appear to have become the most commonly used ratios. Barrels up to 30 diameters in length have been built, but are used primarily in machines used for extraction processes. The longer machines increase the amount of mixing action to which the material is exposed within the extruder. Longer machines enable the processor to improve the uniformity of the extrudate at a given throughput rate, or the throughput rate may be increased without loss of quality (provided that enough power can be transmitted to the screw).

Frequently the question arises, whether it is better to install extra-long machines of a relatively small diameter, or standard-length machines of slightly greater diameter, in order to achieve a given output. Since the power required to extrude at the given rate will be about the same regardless of the machine used, and since the size of the drive required will be identical in either case, it usually develops that no *major* economies can be made by going to a relatively small diameter machine of greater barrel length. In addition, the screw design of the smaller diameter machines operating at relatively high speed becomes more critical.

For these reasons, it appears that the benefits of the longer barreled machines will be found primarily in improvement of extrudate quality, rather than in greatly increased capacity.

Valves at output end

In addition to fundamentally better extruder screw designs, longer barrels and better instruments, improvements in extruder performance have also been achieved through the use of valves at the output end. Installed in die adaptors, these valves enable the operator to control the die resistance. By this expedient it is possible to improve the homogenizing action and the uniformity of delivery of the existing screws which would ordinarily have given unsatisfactory performance (11).

Many recent papers have explained the interrelationship of extrusion variables on the basis of the extruder flow equations, and the use of the more fundamental concepts in typical operating and design problems. The better understanding of the flow pattern inside extruders, and the greater confidence in our ability to design extrusion equipment has led us not only into the construction of larger machines, and of greatly improved machines with significantly higher capacities, but also into the design of extruders for unusual applications or secondary functions such as devolatilization and compounding. One example is the miniature screw pump, shown in Fig. 3, above, which is used to pump an acid mixture in a chemical-waste control system (12). This little ½-in.-diameter screw pump delivers 2 cc./min. at 300 r.p.m. from a screw with a 7-mil-deep channel, and a pitch 7 threads/inch.

More directly in the area of plastics processing, extruders have been used to remove volatiles from resins, extracting these either through the barrel or even through the core of the screw (13). This has been made possible through better understanding of the behavior of plastic melts in partly filled screw channels, and through greater confidence of the flow of plastic materials along the screw.

Auxiliaries better too

Up to this point, we have talked only about the extruder proper. Parallel developments in die design and take-off design are, of course, taking place. New concepts of flow behavior have been established—e.g., melt fracture—(14), and the time-dependent melt properties have come under close scrutiny. These studies and the basic theories of viscous flow, viscoelastic properties of the melts, heat transfer and thermodynamics are being applied to put the design of this auxiliary equipment on a sounder and more scientific basis.

Considerable work has been done in recent years to predict the performance of dies. It has been shown that it is possible to calculate the uniformity of distri-

bution of flow through a die, taking into account the non-Newtonian behavior of the materials involved, and the different rates of shear in various portions of the die body. These calculations have been applied to the design of sheeting dies (15) and blown film dies, and are currently being extended to some irregularly shaped dies.

This does not mean that all future die designs will be calculable. At present—and probably for a good while to come—the theories cannot cope with many common but complicated shapes. Nor are sufficient data available on the flow properties of many of the plastics involved. However, a clearer understanding of the mathematics relating die dimensions to flow will help both the die designer and the extruder in their work.

The design of take-off equipment has until recently been a relatively neglected area, as far as the application of fundamental principles are concerned. However, even here, the tendency is to devote more attention to theoretical considerations, in particular to the principles of heat transfer, in order to avoid needless over-designs and still to provide adequate cooling capacities.

Progress in these areas of extrusion technology has been demonstrated, for example, in wire coating operations where wire speeds of 2000 ft./min. have been reached commercially, and in paper coating where polyethylene is coated in thicknesses of about 1 mil and in web widths of up to 10 ft. at speeds of up to 1000 ft./min. in everyday operations.

Further advances expected

For the future, major technological developments in several areas may be anticipated.

The better understanding of flow patterns in the extruder channel, the new knowledge about mixing processes in screw channels, and the experience gained in the removal of volatiles from materials being extruded make it likely that extruders will be used in increasing measure as reactors for various chemical processes and in finishing operations. It is also likely that better screw mixing devices can now be built according to the newly developed mixing theories.

The refinements of extrusion processes will demand continuing improvements in instrumentation. In particular, it is expected that more sensitive instruments will be needed to record the very minute fluctuations in extrudate temperature and delivery.

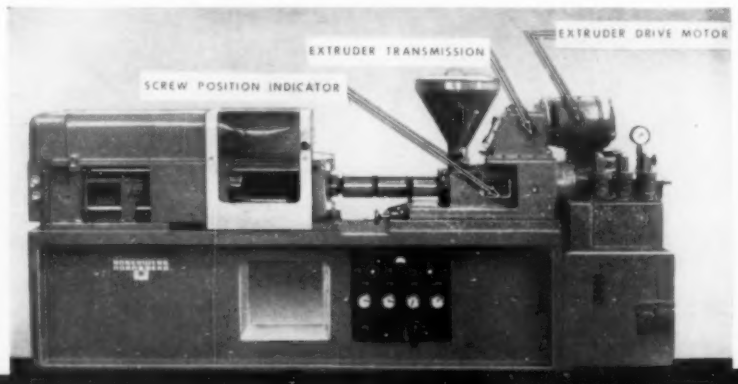
It has long been recognized that extruders are superior to injection molding machine cylinders as plasticating devices. The injection cylinder heats the resin largely by conduction of heat through the layers near the hot walls. This is a very slow process because plastics conduct heat poorly. If a practical heating rate is to be achieved, a large temperature gradient must be built up between the material near the cylinder wall and that farthest away from the heated surfaces. The material near the walls will be hotter by many degrees than the main bulk of the resin. For this reason temperature striations in the resin issuing from the cylinder are likely to be large, particularly at high throughput rates.

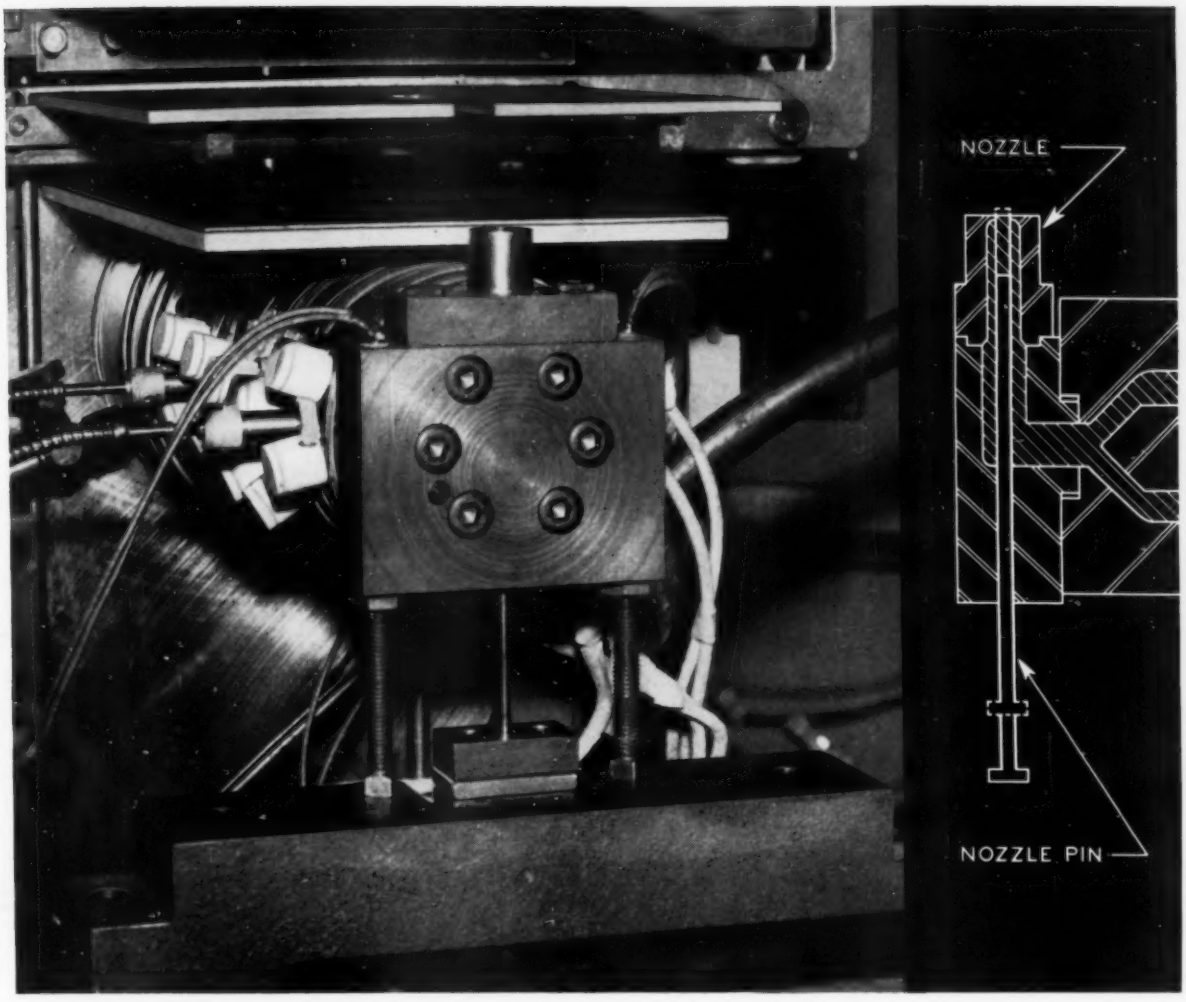
In plasticating extruders, on the other hand, the turning of the screw shears the resin. This shear does work on the resin, thus heating it, and furnishing a major share of the total heat needed to bring it up to the desired temperature. In addition, the screw flights continually wipe material off the heated barrel surface, and cause it to mix with the resin in the channel. As a consequence, a properly designed extruder can produce larger quantities of melt at a more uniform temperature than an injection cylinder of equal size.

It follows, therefore, that new machinery for processing thermoplastic materials is likely to make use of screw melting devices. Progress has already been made in adapting screw extruders for intermittent delivery in order to use them in molding operations. An early attempt in this direction was the Jackson-Church machine, which employed an extruder to plasticate a given quantity of resin for subsequent injection into the mold by a separate ram (16). In a European machine, shown in Fig. 4, below, the screw has a lengthwise as well as rotary motion and acts both as the plasticator and as the ram. Excessive back flow down the screw channel during injection is avoided through proper screw design. The same idea, but using a twin-screw extruder, is the basis of another European design that has been in operation for several years.

In the Foster-Wücher extrusion-molding machine (see Fig. 5, p. 120) a ram has been eliminated altogether (17). The screw is driven through a clutch that permits starting and stopping it rapidly, so that melt may be pumped intermittently into a series of low-pressure molds mounted on a turret. Another more recent machine employing many of the same general principles as the Foster-Wücher has been announced by Troester of Germany. (See MPL, Aug. 1958, p. 154.) However, in both of these machines, since the screw turns only during injection, ultimate plasticating capacity of extruder is not realized. (*To page* 120)

Fig. 4: Reciprocating-screw-type injection molding machine, in which screw plasticates molding powder and also injects melt. (Photo: Ankerwerk, Germany)





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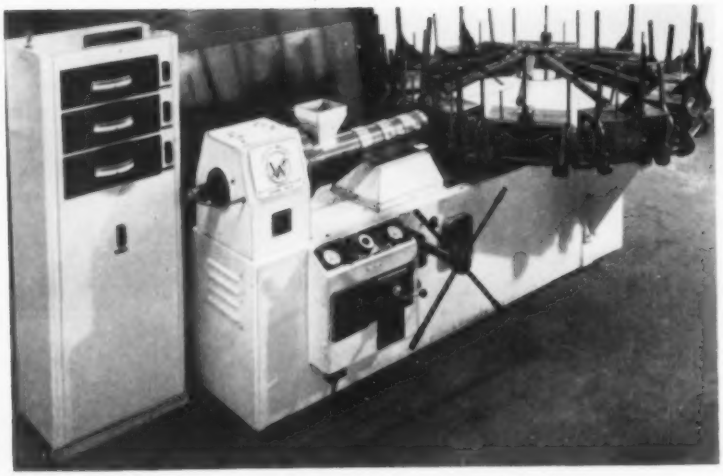

Fig. 5: Foster-Wücher extrusion molding machine. Timed vibratory feeder, normally mounted above drive, has been removed

In our own laboratories we have demonstrated that standard extruders with a *continuously rotating* screw can be made to discharge slugs of melt of uniform weight, and at uniform melt temperature through a single orifice (18). These slugs are ejected at unusually high momentary extrusion rates. They can be formed into desired shapes in a secondary molding operation. This interrupted extrusion is accomplished through the use of an automatically controlled shut-off valve at the extruder head, and a screw design which prevents the build-up of excessive heat and pressure in the resin being processed.

All of this points to the fact that the once-clear division between extrusion and molding equipment is beginning to disappear. It is no longer possible to separate extrusion from molding solely on the basis that extrusion employs a screw device for plasticating the material, and for generating the required pressure. Many new molding machines are likely to incorporate screw devices for the same purpose. However, there will, of course, always remain a distinction between extrusion in the sense of a continuous flow operation as opposed to the discontinuous molding processes.

Up to this point, we have considered primarily the application of extruders, and the technological development of this phase of our industry. The commercial growth of extrusion in our expanding industry is underscored by the following statistics (19): In 1948, about 100 extruders were sold annually in the U. S. This number has now increased to over 800 machines sold per year. The total number of machines has more than quadrupled in this time, and is now close to 7000.

The trend in machine size is underlined by the fact that within the last three years alone, the percentage of large machines (over 4.2-in. in diameter) sold in the U. S. has risen from about 25% to approximately 31 percent.

Conclusions

In summary, it appears that the extrusion industry is at the technological stage where the basic scientific understanding of this process has been established. The great versatility of screw extruders and their utility in large-scale operations are gaining recognition. Attempts to use them in as-yet-unconventional processes will undoubtedly increase. Progress in extrusion technology, and in the industrial application of extruders appears to be taking place at a specially rapid rate even for our burgeoning industry.

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Repairing molds by electroforming

A wide range of durable repair jobs on metal molds, particularly those requiring an even thickness of metal over an area, can be done economically by electrodeposition of nickel

*By W. J. B. Stokes, II**

Nickel electroforming is a relatively new process which has rapidly attained an important place in the repair of metal molds for plastics. It makes possible the repair of mold parts that heretofore would have had to be scrapped; it is often more economical than other repair methods; it makes possible better repairs.

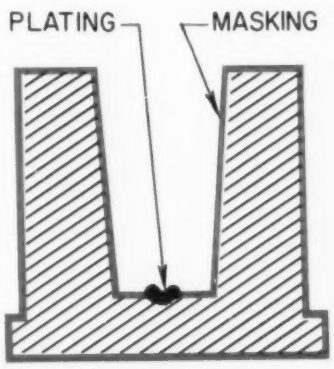


Fig. 1: Plating in the bottom of a deep hole. Masking off sides of the hole makes it, in effect, "electrically shallow"

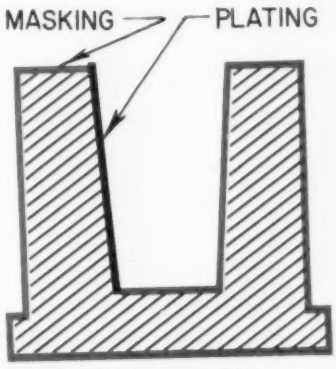


Fig. 2: Plating on side surface of deep hole is easier if done in stages. Here one side is masked; other is plated

History

For many years electroplating has been used in mold repair work. Chrome plating has been most used because it was hard, durable, and readily available. However, it has many limitations. That nickel plating can overcome many of these limitations was recognized by the British Ministry of Supply during World War II. They did considerable research on the use of nickel plating baths for heavy build-up of metal and published several monographs on this work. They found that nickel deposits could be built up to substantial thicknesses—⅛ in. or more—without difficulty; that the ability of the nickel baths to plate into deep recessess was superior to that of chrome baths; that nickel plating deposited metal which was hard yet machineable.

Although the process was very valuable, saving many thousands of dollars worth of parts, there were still several serious limitations. At that time a bath was not available that would deposit metal combining the desired qualities of hardness and ductility. It was not possible to plate into recesses of any considerable depth, although the nickel proved better than chromium in this respect. When substantial thicknesses of metal were built up troublesome extraneous outgrowths called "trees" were encountered.

In 1953 the London and Scandinavian Metallurgical Co., Ltd., London, England, made a great step forward when it developed new plating baths that overcame most of these limitations and gave greatly improved performance. In these new baths, stress in the

* Pres., Electromold Corp., Trenton, N. J.

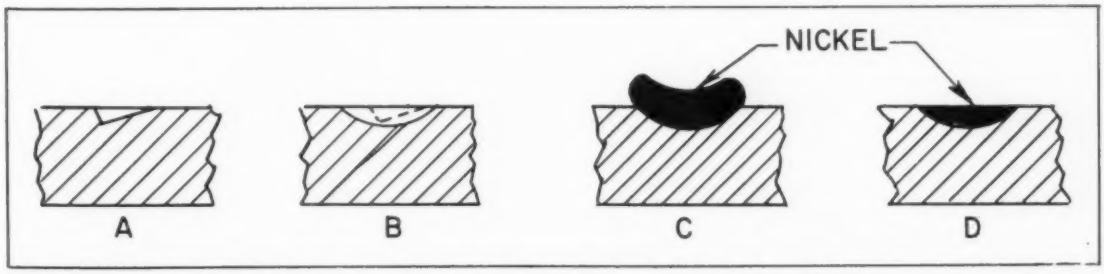
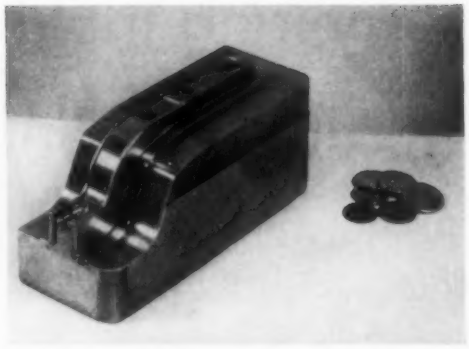


Fig. 3: Successive stages in repairing surface with sharp dent: A) as damaged; B) dished out; C) plated in; D) machined repair

plated metal is reduced almost to the vanishing point. The deposits are both satisfactorily hard and ductile. The baths also have tremendous "throwing power," i.e., the ability to get metal down into deep recesses. These baths plate evenly with a minimum of excess build-up at corners and edges, making a deposit that is readily machined and free from pits.



A force plug was too narrow in one part: the sides of the raised area were built up about 15 mils with electrodeposited nickel. Coins at right show relative sizes

The process

The nickel repair process embodies many steps, each step requiring great care and attention. Hospital standards of purity must be maintained in the chemicals used. Constant analyzing and readjusting of the various chemical baths is necessary.

When a part is received for plating build-up, the first move is to find out how much metal is needed and where. This information must be carefully checked because an error here can be costly in time and money. For this reason clear, definite sketches or, better yet, marked working drawings, should be supplied to the plater.

An item to be plated is first cleaned in a chemical bath. (This operation removes all crayon or blue marks which may have been used to show where the build-up is required, hence the need for accurate written information on this.) This cleaning is necessary to insure the adhesion of the masking material which protects the areas that are *not* to receive the new metal.

The areas to be plated are first protected by various means, and the masking is then applied by brushing, dipping, or spraying. Several coats are required of several different materials, the first to provide a sharp delineation of the masked area and the top layer to protect the others in handling. The areas where the new metal is desired are then exposed, electrical leads are connected, and the part is ready for its trip to the plating baths.

This is a trip with many stops and check points. First the part gets a second, and final, degreasing in baths especially developed for mold parts and similar metal pieces. Next is an inspection, checking the completeness of the degreasing. Then there is a chemical dip, a wash, and another inspection. Then one more chemical treatment, another wash, another inspection, and into the plating baths. Ringing timers are used in these steps because proper timing is vital to success.

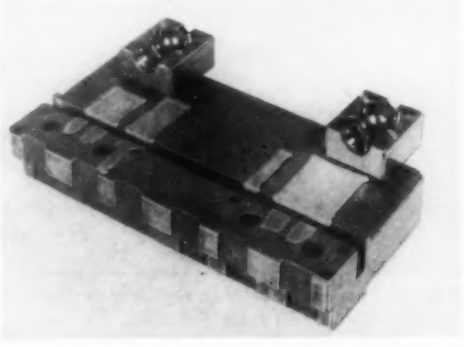
After the parts are in the plating baths, they continue to require attention to make sure there are no imperfections in the deposit, and that the masking is holding securely. After the parts have been in the plating baths for several hours, they can be left alone for a calculated length of time after which they are checked to determine whether the build-up is sufficient for removal.

Since the plating bath is almost as black as ink, such inspections are not easy and special equipment and techniques are called for. The part cannot be removed from the solution until the plating is completed, as interruption of the plating current can cause a weak interface at the point of interruption. The plating baths are operated from batteries to insure that there will be no interruption of current because of electric line failure. If, however, there should be an interruption through handling or other accident, the plating can be resumed by repeating the above preparatory routines, with variations.

The details of the routine depend upon the metal base being plated. Nickel can be plated on practically all of the metals ordinarily used in mold making. The common steel alloys, electroformed nickel, and beryllium copper take the deposit easily. Stainless steel can be plated upon but requires certain techniques that the electroforming shop may not have available. The preparation routines must be varied to suit the analysis of the steel and its heat treatment history. Therefore, it is important that the plater be given that information if he is to achieve the best bond between the plated and base metals.

Capabilities

In these new English baths the plated metal goes on quite evenly at all exposed points, and is smooth and free of pits. Into how deep a hole the metal can be "thrown" depends not so much on the physical depth of the recess as on its "electrical" depth. Electrical depth is essentially the depth of the unmasked metal ex-



Several galled areas in mold bar were restored by electroforming. Welding such a bar might have warped it. Resting on the bar are two cavities whose lengths have been extended by electroforming

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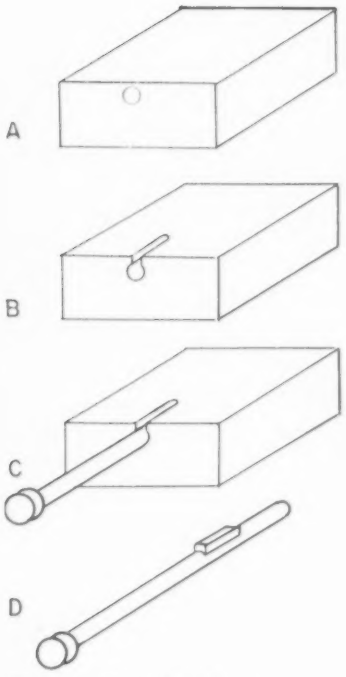


Fig. 4: Electroforming a key on a pin: A) hole is drilled into plastic block; B) slot is cut into hole; C) pin is inserted into hole and key is plated on (projecting part of pin is masked); D) finished pin has an integral key

posed to the bath. The drawing of Fig. 1, p. 121, shows the metal being plated at the bottom of a physically deep but electrically shallow cavity whose sides are masked all the way down. Such plating is easy since no side currents divert the metal ions from the bottom of the hole.

The sketch in Fig. 2, p. 121, shows the plating of the side of the same cavity. This cavity is now deep electrically, and ions are likely to follow the shorter paths near the top, resulting in progressively greater build-up from the bottom up. However, with baths of very high throwing power, important amounts of metal can be plated onto the side of such cavities all the way to the bottoms. If both sides of the cavity are exposed, the difficulty of reaching the bottom is tripled, not just doubled, but frequently this can be circumvented by plating one side of the cavity at a time.

One of the problems in plating into small slots is masking: The thickness of the masking materials tends to fill too much of the aperture. In plating into any slot or hole there will be more metal deposited at the top edge than anywhere else, and the metal will be thinnest at the bottom. However, using the English baths with their greatly increased throwing power, a substantial amount of metal can be plated deep into even these recesses.

While the location of the plated metal can be accurately controlled by proper masking of the part, the thickness of the deposit cannot be, for three reasons: 1) the thickness will vary somewhat over the area being plated; 2) estimated plating rates are not an accurate guide to plating thickness; and 3) measurement of the amount deposited is very difficult because all exposed metal will plate, making it hard to find points of reference on any piece except one which is being plated around its periphery. The general answer to this problem is to use plating time as a rough guide to the amount deposited, with a safety factor.

The thickness that can be plated on is limited only by time and money. In making mold cavities by electroforming, thicknesses of 1 to 2 in. are frequently built up. It is possible to deposit this amount on base metal, but many weeks of plating would be required and the expense would be heavy. The average build-up is less than ⅛ inch.

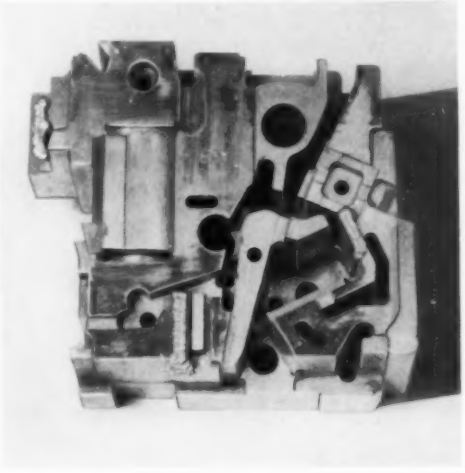
This process is essentially for *area* repairs. It cannot bond two pieces of metal together. It will not cover cracks or pits; rather, sharp breaks in a surface will be reproduced fairly faithfully by the plated metal. However, pitted metal can frequently be restored by machining over the pitted area so that the "smearing" of the machined metal covers the pits. Sound metal can then be plated over this smeared metal.

Some holes and slots can be filled by plating. This is done by modifying the hole or slot by dishing it out into a relatively shallow depression and filling this bowl-like depression with plated metal. The stages of this technique are sketched in Fig. 3, p. 121.

A few of the most common uses of the process in the repair of molds for plastics are: Rebuilding raised detail, keys, lettering, etc.; altering lettering, either raised or depressed; filling in gates; building up force plugs to reduce wall thickness of the molded part, or to reduce local thick areas; rebuilding crushed lands; rebuilding worn stripper plates or side-action details; adding metal to the parting line area for rematching of irregular-parting-line cavities; rebuilding the top area of cavities to increase their depth; shortening cavities that are too long; building up worn ejector-pin holes; building up cavity inserts to provide a closer fit.

Special features

An interesting example of the method's possibilities is the forming of keys on round pins. To do



An intricate cavity part on which several dimensions were shy. At right center of the force there is an electroformed build-up extending well down into the recess. Note that none of the adjacent sharp edges has been rounded or otherwise damaged

Four W-S 64-ounce, preplasticizing-type, horizontal, injection molding machines in operation at the J. P. Gits plant.

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this, a hole is drilled into a piece of plastic near its edge, then slotted lengthwise, and the pin is inserted into the hole. See Fig. 4, p. 124. The plating goes down onto the pin in the area exposed by the slot in the plastic, thus forming a key on the pin. The cost of making a key by this method can be a fraction of the cost of milling a keyed pin from a solid piece of metal.

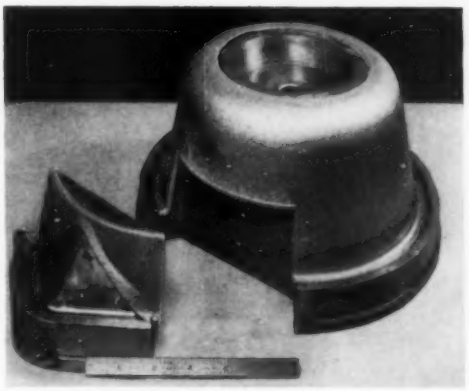
There are many similar parts where the projecting elements can be electroformed on a simple base piece more economically than the base metal can be machined away to leave details standing out from the main body.

Copper with a hardness of about 16 Rockwell C is occasionally used to advantage in building up molds. Copper plates faster than nickel, therefore, a greater thickness can be achieved more quickly.

Although the copper will not take a high polish, it can be subsequently plated with nickel or chrome to increase its resistance to wear, as well as to prevent corrosion.

One interesting use of copper build-up on steel parts is to improve the distribution of heat in steel parts. In some applications, local heating of the steel creates a problem because steel conducts heat poorly.

The plating of a substantial layer of copper—which has approximately nine times the thermal conductivity of steel—on the outside or on the back of such steel parts can do a great deal to level the temperature distribution in the steel.

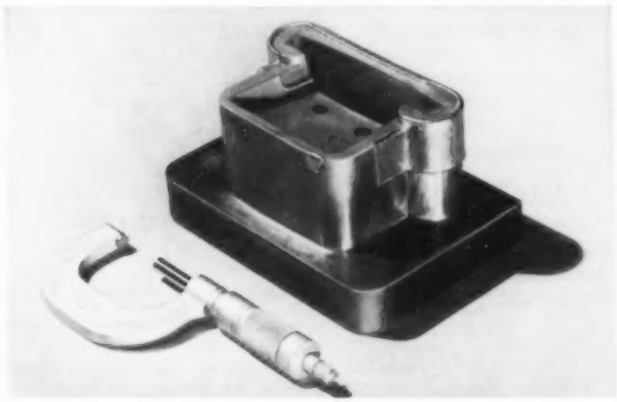


Force plug which was built up to reduce the wall thickness of the moldings by about 25 mils. The 6-in. ruler in foreground gives size comparison

Pros and cons

The chief drawback of mold repair by electroforming is the exacting nature of the process. It is rarely feasible for individual molding and tooling shops to do this work themselves, so parts to be repaired must be shipped to the electroformer's plant, with attendant delays. When urgency is great, it may pay to make the repair (possibly an inferior one) by depositing the metal by welding in one's own shop. (That method, too, has its limitations, and it is doubtful, for example, that a deposit of the kind shown in Fig. 2 could be made by welding or brazing.) Heavy electrodeposits are expensive. Some damaged surfaces must first be machined to gentle curvature before repair can be started, as in Fig. 3.

On the positive side of the ledger are the many advantages of electroforming over other repair methods: No great heat, local or general, is used since the plating baths operate at about 120° F. There is no danger of burning off adjacent sharp edges, or of depositing metal where it is not wanted. Hardness of the deposited metal is predetermined, in the range from 40 to 48 Rockwell C, and is closely controlled, so there are no flint-hard or dead-soft spots. There is no danger of thermal stressing or distortion of the base metal. There are no cracks along the edge of the repair area, and the interface can be finished so well as to be indiscernible on the molded pieces. Areas not reachable by other methods can be built up by electroforming. For these reasons, this versatile and economical process should be valuable to all users of metal molds.—END



A mold insert that was refitted into a larger chase by electrodeposition. The mold maker feared that welding might cause cracks in the sharp corners of the cavities, resulting in distortion of the long thin side

A stripper ring had worn oversize; it was put back into production by building up the working surface with hard electroformed nickel

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S.P.E. technical conference

Program and papers to be presented at the 15th annual meeting

The 15th annual technical conference of the Society of Plastics Engineers will be held Jan. 27-30, 1959 at the Hotel Commodore New York, N. Y.

At noon on Tuesday a membership meeting and annual business session will be held. There will be a luncheon on Wednesday. On Thursday evening there will be a dinner dance, which will include entertainment.

The program of the technical sessions follows:

Tuesday morning, Jan. 27

Session 1: Latest developments in stereospecific polymers. *Moderator, Prof. Herman F. Mark, Polytechnic Institute of Brooklyn, N. Y.*

"Propylene and Copolymers of Propylene and Ethylene—Synthesis & Structure." *Frank C. McGrew, E. I. du Pont de Nemours & Co., Inc.*

"Polyolefin Production with Preformed Solid Catalysts," *Dr. A. A. Harban, E. Field and H. N. Friedlander, Standard Oil Co. (Ind.).*

"Polybutadienes of Controlled Cis, Trans, and Vinyl Structures." *J. N. Short, C. Kraus, R. P. Zelinski, and F. E. Naylor, Phillips Petroleum Co.*

"Stereospecific." Complete title not yet known. *Prof. Giulio Natta, Polytechnic Institute of Milan, Italy.*

Tuesday afternoon

Session 2: Topics of special interest. *Moderator, Dr. Robert B. Mesrobian, Continental Can Co.*

"Effect of Gamma Radiation on Plastics." *R. R. Stromberg, B. G. Achhammer, National Bureau of Standards.*

"Non Destructive Testing." *Dr. Johan Bjorksten, Bjorksten Research Laboratories, Inc.*

"Chain Rupture by Shear in Molten Polymer." *H. A. Pohl and J. K. Lund, Princeton University, The Plastics Laboratory.*

"Instruments as Tools of Automation." *Richard A. Wade, Brown Instrument Div., Minneapolis-Honeywell Regulator Co.*

Session 3: Thermoforming. *Moderator, Robert Bostwick, Union Carbide Plastics Co.*

"Machine and Mold Requirements for Vacuum Forming High-Density Polyethylene." *R. F. Spill, F. L. Quinly, and R. A. D. Wentworth, W. R. Grace & Co.*

"Vacuum Forming Polyolefins." *J. Y. Lomax, Hercules Powder Co.*

"Thermoforming Characteristics of Extruded and Calendered Linear Polyethylene Sheet." *C. K. Henry, Celanese Corp. of America.*

"New Film and Sheet Plastics; Their Properties & Application in Packaging" combined with "New Advances in the Technology of Thermoforming Biaxially Oriented Film and Sheets." *J. Murphy, Monsanto Chemical Co.*

Session 4: Extrusion—Part I. *Moderator, Robert Sackett, Monsanto Chemical Co.*

"Sheet Extrusion Problems and Solutions." *A. L. Griff, Union Carbide Plastics Co.*

"Injection Molding and Extrusion of Polyethylene." *Russell D. Hanna, Hercules Powder Co.*

"The Extrusion of Expandable Polystyrene as Film." *S. M. Kline and S. J. Del Bene, Koppers Co.*

"Latest Improvements in Nylon Film Extrusion." *R. L. Hughes and P. Simpson, Spencer Chemical Co.*

Session 5: Injection molding, Part I. *Moderator, Saul Blitz, Tico Plastics, Inc.*

"High Frequency Preheating and Plunger Molding of PVC and Other Heat Sensitive Thermoplastics." *T. H. Baylis, Union Carbide Plastics Co.*

"Extruder Pressure Control Tests." *Glen Pettit, Barber-Colman Co., Wheelco Instrument Div.*

"Advanced Technique of Pre-Plasticizing on Small Injection Molding Machines." *Ernest P. Moslo, Moslo Machinery Co.*

"Vented Reverse Flow Heating Cylinders." *A. R. Morse, Injection Molders Supply Co.*

Session 6: Educational symposium. *Moderator, R. C. Bartlett, Chairman, S.P.E. National Education Committee.* Theme: Training of Technicians.

Wednesday morning, Jan. 28

Session 7: Plastics in high-temperature electrical insulation. *Moderator, Dr. Sidney J. Stein, International Resistance Co.*

"High Temperature Wire Enamels." *William Skinner, Essex Wire Corp.*

"Heat-Resistant Encapsulating Resins." *Max M. Lee, General Electric Co.*

"Radomes at Elevated Temperatures: Theory and Practice." *Fred H. Behrens, Radome Branch, Wright Air Development Center.*

"Relationship of Molecular Structure to Electrical Characteristics at Elevated Temperatures." *Professor A. R. Von Hippie, Massachusetts Institute of Technology.*

Session 8: Aesthetic aspects of plastics. *Moderator, Gordon K. Storin, Speer Carbon Co.*

"The Art of Large Area Aesthetic Embedments." *Dr. Alex Gurwood, Dearborn Glass Co.*

"The Practical Application of Color Theory and Color Instruments to Plastic Color Problems." *R. G. Feeney, Celanese Corp. of America.* (To page 130)

"Nacreous Pigments: The Infinite Colorant." *George E. Meyers, Rona Laboratories.*

"Thermosetting Resins: The Artists' and Architects' Dream Materials." *Armand G. Winfield, DeBell & Richardson, Inc.*

Session 9: Vinyls. *Moderator, Dr. Frank Greenspan, Food Machinery & Chemical Corp.*

"Vinyl Resins." *F. R. Bukey, Firestone Plastics Co.*

"Vinyl Stabilizers." *Charles H. Fuchsman, Ferro Chemical Corp.*

"Vinyl Plasticizers." *J. J. Morris, Union Carbide Chemicals Corp.*

"Plastisol, a Labor-Saving Device." *Hugh B. Allison, Chem-o-sol Sales.*

Session 10: Mold design—Part I. *Moderator, Ernest J. Csaszar, Newark Tool & Die Co.*

"Fundamentals of Mold Design." *S. E. Tinkham, Boonton Molding Co.*

"Inherent Qualities of Plastic Mold Steels." *E. E. Lull and William Young, Crucible Steel Co. of America.*

"Methods of Cavity Construction." *Jerome J. Stern.*

"Mold Frame Construction." *George Beck, Columbia Engineering Co.*

Wednesday afternoon

Session 11: Reinforced plastics. *Moderator, Dr. Rusell W. Ehlers, Lowell Technological Institute.*

"Reinforcement." *R. W. Amidon and G. Goldfinger, Naugatuck Chemical Co.*

"The Latest Developments in Glass Finishes." *Dr. J. Bjorksten, Bjorksten Laboratories, Inc.*

"A Statistical Study of the Effects of Variations in Glass Fabric on the Properties of a Resin-Glass Fabric Laminate." *William J. Eakins, DeBell & Richardson, Inc.*

"Relations of Physical and Chemical Properties to the Structure of Thermoset Resins." *E. H. Wood, Union Carbide Plastics Co.*

Session 12: Blow molding. *Moderator, Elmer E. Mills, Highland Park, Ill.*

"Blow Molding." *Grant Brown, Plax Corp.*

"Blow Molding—Comparison of Principles Related to Economics and Marketing." *Vernon Hill, Celanese Corp. of America.*

"Molds for Blow Molding." *John Redman, Redman Pattern Works.*

"Blow Molding Polyethylene." *R. L. Wechsler, Union Carbide Plastics Co.*

Session 13: Extrusion, Part II. *Moderator, James F. Carley,* MODERN PLASTICS *Magazine.*

"A Visual Analysis of Flow and Mixing in Extruder Screws." *B. H. Maddock, Union Carbide Plastics Co.*

"The Significant Flow Properties of Thermoplastics." *Leonard B. Ryder, Celanese Corp. of America.*

"Continuous Extrusion and Thermal Curing of a Heat-Curable Wire Coating." *Philip H. Rhodes, Philip H. Rhodes and Assoc.*

"Vent and Valve: Its Importance in Modern Extrusion." *A. A. Kaufman, F. Nissel, Prodex Corp.*

Session 14: Injection molding, Part II. *Moderator, Gerard C. Heldrich, W. R. Grace & Co.*

"Mechanical Blends of Low-Density Polyethylene and 'Grex'" combined with "The Effect of Inorganic Fillers on the Physical Properties of Linear Polyethylene." *J. B. Wolheim, A. A. Haas, and J. J. Whidden, W. R. Grace & Co.*

"Injection Molding of 'Teflon' 100X FEP Fluorocarbon Resin." *H. A. Larsen, G. R. DeHoff, and N. W. Todd, E. I. du Pont de Nemours & Co., Inc.*

"Plastic Flow as Interpreted by Birefringence." *R. L. Ballman, Monsanto Chemical Co.*

"Technological Limitations to the Expansion of Industrial Custom Molding." *Fred Tully, Amos Molded Plastics Co.*

Thursday morning, Jan. 29

Session 15: Printed circuits. *Moderator, Edward B. Murphy, Lincoln Laboratories, Massachusetts Institute of Technology.*

"Continuous Peel Strength Measurement of Copper Clad Laminates." *Charles Kepple, Motorola, Inc.*

"Protective Coatings for Missile Printed Circuits." *W. E. Weber and A. E. Hawley, Hughes Systems Development Laboratories, Hughes Aircraft Co.*

"Molded Circuits." *P. L. Anderson, Rogers Corp.*

"Microminiaturization in Printed Circuits." *Philip J. Franklin, Diamond Ordnance Fuse Labs.*

Session 16: Plastics in building. *Moderator, Dr. William Goggin, Dow Chemical Co.*

"Special Purpose Styrene Material." *R. A. McCarthy, Daniel A. Popielski and Francis J. Pokigo, Monsanto Chemical Co.*

"More Plastics—Better Buildings." *E. E. Ziegler, Dow Chemical Co.*

"Permanence Properties with Regard to Plastics in Buildings." *Prof. Albert G. H. Dietz, Massachusetts Institute of Technology.*

"Plastics in Buildings?" *George Nelson, George Nelson & Co.*

Session 17: Test methods. *Moderator, Dr. Frank W. Reinhart, National Bureau of Standards.*

"A Critical Review of Methods for Determining Hardness of Plastics." *Ladeslav Boor, Instrument Engineering Branch, Philadelphia Quartermaster Depot.*

"A Review of Stress Cracking in Ethylene." *J. B. Howard, Bell Telephone Laboratories, Inc.*

"A Critical Review of Methods for Measuring Flammability of Plastics." *W. J. Sauber, Dow Chemical Co.*

"A Critical Review of Methods for Determining Properties of Reinforced Plastics at Elevated Temperatures." *Donald L. Schmidt and George P. Peterson, Wright Air Development Center, Wright-Patterson Air Force Base.*

Session 18: Mold design, Part II. *Moderator, John A. Kavanagh, Standard Tool Co.*

"Mold Heating—Steam vs. Electricity." *Harold Cook and Howard Luke, Tech Art Plastics Co.*

"Hot Runner Molding Techniques." *P. J. Boeke, J. N. Scott and D. L. Peters, Phillips Chemical Co.*

"Casting Large Plastic Tools." *Frank L. Bogart, Marblette Corp.*

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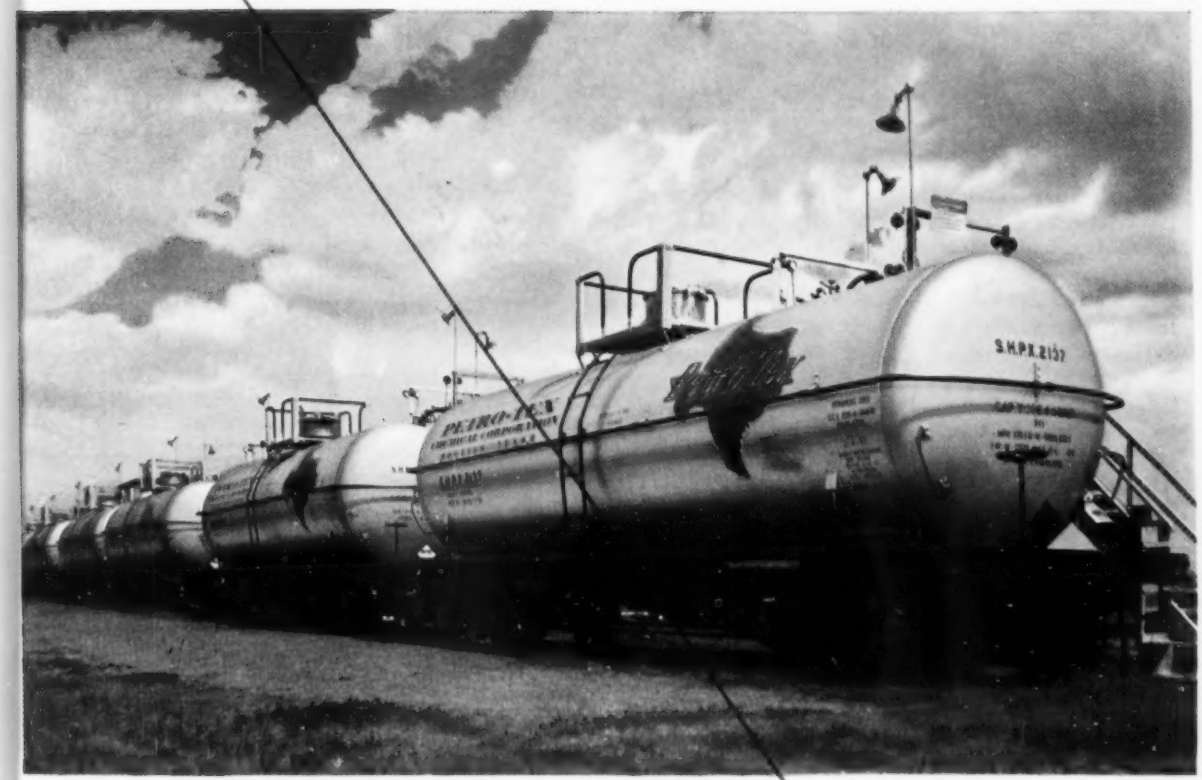

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Richard Bell, International Business Machines Corp.

Thursday afternoon

Session 19: Ultra high temperature reinforced plastics. *Moderator, Dr. William R. Lucas, Army Ballistics Missiles Agency.*

"Designing Reinforced Plastic Systems for Ultra High Temperature Use." *Dr. Elber P. Warnken, Cincinnati Testing & Research Laboratories.*

"The Behavior of Reinforced Plastics in Contact with Hot Gases." *H. Perry, I. Silver and H. Anderson, Naval Ordnance Labs.*

"Appreciation of Reinforced Plastics to Re-entry Ablation." *Dr. M. A. Bruell, School of Civil Engineering, University of Pa.*

"Reinforced Plastics in Rocket Motors." *George Epstein, Aerojet-General Corp.*

Session 20: Cellular plastics foams. *Moderator, Alan J. Breslau, Thiokol Chemical Corp.*

"Foam Plastics." *C. R. Davall, Union Carbide Plastics Co.*

"Glass Microballons." *W. R. Cuming, Emerson & Cuming Inc.; H. E. Alford and F. Veatch, Standard Oil Co. (Ohio).*

"New Polyether Triols for Urethane Foams." *J. McClellan, Wyandotte Chemical Corp.*

"Modified Rebound Pendulum for the Evaluation of Flexible Foam Materials." *L. A. Rosenthal and G. I. Addis, Union Carbide Plastics Co.*

Session 21: Epoxy resins. *Moderator, Jerome Bassin, The Borden Co.*

"Properties of 'Epi-Res' 5161, a New Chlorinated Epoxy Resin." *Dr. H. G. Cooke, Jr., Jones-Dabney Co.*

"Reactive Diluents in Epoxy Resin Systems." *F. E. Pschorr and E. N. Dorman, Ciba Co., Inc.*

"'Mod-Epox,' A Unique Reactive Diluent For Epoxy Resins." *D. P. Ames, H. D. Barnstordd, J. A. Cannon, and H. D. Cummings, Monsanto Chemical Co.*

"Refractive Index Method for Determining Cure Rates of Epoxy Resins." *Hans Dannenberg, Shell Chemical Co.*

Session 22: Plastic packaging: Workshop. *Moderators, E. A. Haddad and R. R. Moyer, Monsanto Chemical Co.*

"New Trends in Plastic Film Materials." *Section Moderator, Dr. Leonard Simerl, Olin Mathieson Chemical Co.*

"Linear Polyethylene Packaging Film." *W. L. Fawcett, Phillips Chemical Co.*

"Polystyrene Film." *Donald Meiklejohn, Monsanto Chemical Co.*

"Polyester Films." *H. S. Carl, E. I. du Pont de Nemours & Co., Inc.*

"New Trends in Injection Molding Equipment and Methods." *Section Moderator, John Press, Federal Tool Co.*

"Special Purpose Machines for Package Molding." *George Whitehead, Improved Machinery Corp.*

"Molding Equipment and Techniques of Thin-Wall Containers." *David Sloane, Lester Phoenix Machinery Co.*

"A New Concept of High Speed Injection Molding." *Edward Forth, Reed-Prentice Div., Package Machinery Corp.*

"New Trends in Thermoforming Equipment and Methods." *Section Moderator, E. B. Stratton, Auto-Vac Div., National Tool Co.*

"Machine Design." *Eugene Weber, Hydrochemic Co., Zurich, Switzerland.*

"Pressure Forming Machinery." *John Murray, Emhart Mfg. Co.*

"The Function of the Custom Former in Packaging." *Milton Shaw, Shaw-Randall Co.*

"Design Graphic Arts and Application Factors." *Section Moderator, Dr. Louis C. Barail.*

"Trends in Design." *Archibald Drummond, W. D. Teague.*

"New Developments in Printing Inks for Plastic Film." *Douglas Tuttle, Interchemical Corp.*

"The Influence of Electronic Surface Treatment of Polyethylene Film." *H. E. Wechsberg and G. B. Webber, Monsanto Chemical Co.*

Friday morning, Jan. 30

Session 23: New materials. *Moderator, Robert Sherman, Union Carbide Plastics Co.*

"New Developments in ABS Polymers." *Howard H. Irvin, Marbon Chemical Co.*

"Elkinite Resins—Reverse Polyesters." *Irving E. Muskat, Elkin Chemical Co.*

"A New High Temperature Thermoplastic Resin." *W. E. Manring, B. F. Goodrich Chemical Co.*

"Progress in New Materials Research." *Irving Skeist, Skeist & Schwarz Laboratories, Inc.*

Session 24: Adhesives. *Moderator, Jerome Been, Rubber & Asbestos Corp.*

"New Developments in 100% Solids Elastomeric Adhesives." *E. M. Chmiel, Minnesota Mining & Mfg., Co.*

"New Developments in 100% Solids Epoxy Resin Based Adhesives." *Martin M. Grover, Rubber & Asbestos Corp.*

"New Hot Melt Adhesives and Applying Equipment." *John Eldredge, B. B. Chemical Co.*

"The Chemistry and Some Performance Characteristics of Cyanoacrylate Adhesives." *Dr. H. Coover, Tennessee Eastman Corp.*

Session 25: Permanence properties. *Moderator, Dr. Turner Alfrey, Dow Chemical Co.*

"Comparison of Time Dependent Mechanical Properties of Plastics." *Prof. Bryce Maxwell, Princeton University.*

"Creep Behavior of Transparent Plastics at Elevated Temperatures." *F. L. McCrackin and C. F. Bersch, Natl. Bu. of Standards.*

"Comparison of Short-time Versus Long-time Properties of Plastic Pipe Under Hydrostatic Pressure." *Leonard F. Sansone, Jr., National Tube Div., U. S. Steel Corp.*

"Effect of Space Conditions on Plastics." *John J. Lamb, Radio Corp. of America.*

Session 26: Compression molding. *Moderator, Edward Vail, Union Carbide Plastics Co.*

"Pastel Colored Polyester Molding Materials." *Edward F. Borro, Durez Plastics Div., Hooker Chemical Corp.*

"Rotary Molding." *J. C. Reib, Rainville Co., Inc.*

"Technology in Application of Very High Frequency Electronic Preheating for Thermoplastic Molding." *J. F. Trembley, W. T. La Rose Assoc., Inc.*

"Insert Blow Loading." *J. W. Shannon, Whitso, Inc.*—END

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Plastics Technical Section

Dr. Gordon M. Kline, Technical Editor

Surface erosion of filled plastics

By S. B. Newman†, S. D. Toner†, and B. G. Achhammer†

Reinforced plastics were exposed to 50 cycles of washing with a hot detergent solution, rinsing, and drying. The materials studied included glass-fabric laminates prepared with polyester, diallyl phthalate, phenolic, and epoxy resins, and panels molded from phenolic and melamine molding compounds containing both organic and inorganic bulk fillers. In most cases the cyclic wetting and drying resulted in surface erosion that led to crazing, cracking, and surface exposure of the fibrous fillers. As a group the molding compounds were poorer than the glass-fabric laminates in their resistance to surface erosion. A phenolic molding compound with nylon flock filler was outstanding in resistance to surface erosion and two melamine molding compounds with chopped-cotton-fabric filler showed comparatively little surface damage after exposure to the 50 cycles of wetting and drying. The phenolic laminates with one exception were inferior to the polyester laminates in erosion resistance. The epoxy laminate included in this investigation appears to be higher in resistance to surface erosion than the polyester laminates. An overlay of metallic foil, polyethylene terephthalate film, or gel-resin coating is suggested for increasing the resistance of filled plastics to surface erosion.

Plastics are often used in parts that must undergo periodic decontamination. Most frequently this decontamination is accomplished through exposure to water containing a detergent, often at temperatures close to the boiling point. For structural applications the base resin is usually reinforced with fibrous fillers such as glass cloth, glass rovings, yarns, rag fragments, or fibers.

These filled plastics can be molded into sheets with high surface gloss and physical integrity. Upon exposure to the wetting and drying cycles encountered during decontamination, however, considerable visible change takes place in the surface of many filled materials.

Surface deterioration under these conditions is often quite rapid, particularly when accompanied by abrasion. The changes are undoubtedly related to those observed in similar materials that have been exposed to weathering. The apparent migration of glass fibers to the surface of reinforced polyester panels is a familiar example. In reality, of course, this change is the result of surface activity which erodes away the resin and bares the fiber.

While the over-all changes in surface characteristics are usually sufficiently gross to be visible to the unaided eye, the details are only resolvable by microscopic techniques. These details reveal many of the stages in the surface degradation and provide a means for determining the mechanism of surface erosion. This, in turn, may lead to the fabrication of materials with improved resistance to the surface stresses.

Materials

Panels were molded from a variety of low-pressure laminating resins and plastic molding compounds selected on the basis of their probable resistance to decontamination procedures. The low-pressure laminates were made with 12 plies of 181 type glass cloth having a Volan A fiber finish. The details of their fabrication are listed in Tables I, p. 136, and II, p. 138.

The laminating resins were those designed for use at molding pressures below 500 p.s.i. and consisted largely of polyesters containing styrene or diallyl phthalate as cross-linking agents. Also included were diallyl phthalate prepolymers, phenolic resins, and an epoxy resin. All of these resins were obtained as liquids which, with the exception of the phenolics contained 100% reactive ingredients. The phenolics contained from 58 to 66% reactive ingredients.

The molding compounds were designed for use at molding pressures above 1000 p.s.i. and consisted of organic or inorganic bulk fillers preimpregnated with melamine, phenolic, or modified phenolic resins.

The specific gravities and resin

* Reg. U. S. Pat. Off.

† National Bureau of Standards. This investigation was conducted at the National Bureau of Standards under the sponsorship and with the financial assistance of the Quartermaster Research and Development Command, U. S. Army.

Table I: Low-pressure laminating resins evaluated for erosion resistance. (Phenolics and epoxy fabricated in an open mold. All others in a closed mold.)

Sample number	*Catalyst added*	*Cure*		*Molding pressure*
		Time	*Temp.*	
		min.	*° F.*	*p.s.i.*
		Phenolic Resins[a]		
C-2	1% Hexa[c]	[d]	[d]	[b]
C-3	1.5% Hexa	[d]	[d]	[b]
C-4	7.5% Hexa	[d]	[d]	[b]
F-1	—	30	325[e]	100
G-2	—	5	325[e]	100
P-4	—	30	325[e]	100
V-1	—	30	325[e]	100
		Epoxy Resin		
T-2	Agent Z[h]	63	300[e]	[g]
		Diallyl Phthalate Resins		
M-1	4% ATC	[f]	[f]	50
T-1	4% ATC	[f]	[f]	50
		Polyester Resins		
A-2	1% ATC[i]	10	220	50
A-3	1% ATC	10	220	50
A-4	2% ATC	10	230	50
A-5	2% ATC	15	220	50
B-1	2% ATC	10	250	50
C-1	2% ATC	10	240	50
D-1[j]	4% ATC	20	250	50
D-2	2% ATC	15	250	50
D-3	2% ATC	15	250	50
E-1	2% ATC	30	250	50
G-1	2% ATC	10	250	50
H-1	3% ATC	10	250	50
J-1	2% ATC	15	240	50
J-2	2% ATC	15	240	50
K-1	2% ATC	15	250	50
K-2	2% ATC	15	250	50
K-3	2% ATC	15	250	50
K-4	2% ATC	15	250	50
K-5	2% ATC	15	250	50
K-6	2% ATC	15	250	50
K-7	2% ATC	15	250	50
L-1	2% ATC	15	240	50
L-2	2% ATC	15	240	50
L-3	2% ATC	15	240	50
N-1	1.5% ATC	15	250	50
P-1	2% ATC	30	220	50
P-2	2% ATC	15	275	50
P-3	2% ATC	30	220	50
R-1	2% ATC	30	250	50
R-2	2% ATC	30	250	50
R-3	2% ATC	30	250	50
S-1	2% ATC	20	270	50

[a] Reactive resin content: (C-2)-61%, (C-3)-64%, (C-4)-66%, (P-4)-58-64%, (V-1)-58-62%. Others not reported. [b] Five min. at 20 p.s.i. followed by 60 min. at 100 p.s.i. [c] Hexamethylenetetramine (33⅓% solution in water/ethanol 1:1). 1% by weight of this solution in resin. [d] Mold was preheated to 240° F. Panel was cured for 5 min. at 240° F., followed by 60 min. at 320° F. [e] Mold was preheated to the curing temperature prior to inserting the preimpregnated glass fabric-resin lay-up. [f] 15 min. at 200° F. followed by 30 min. at 235° F., then 15 min. at 275° F. [g] Contact pressure for 3 min., followed by 50 p.s.i. for 60 min. [h] Aromatic amine type; 20 parts added per 100 parts resin. [i] Consists of 50% benzoyl peroxide and 50% tricresyl phosphate. [j] Contained diallyl phthalate monomer.

contents of the panels tested are given in Tables III, p. 140, and IV, p. 141.

Molding procedures

A 12 by 12 in. positive compression mold was used to make the low pressure laminates. It was equipped with a removable chase and could be used both as an open or closed mold. It was used as an open mold for the phenolic and epoxy resins; the polyester and diallyl phthalate resins were molded with the chase in place. The closed mold was used whenever possible, since it permits more exact control of the resin content of the laminate. Use of the open mold allowed for the rapid escape of residual volatile materials contained in the phenolic resins and for flow-out of excess resin from both the phenolic and epoxy laminates. The high-pressure molding materials were molded in a closed 3 by 8 in. positive compression mold.

Preparation of glass fabric

The glass fabric required as reinforcement for the low-pressure laminates was cut into 11½ by 11½ in. squares and sorted, by a system of random numbers, into stacks of 12 plies each. In order to remove any excessive amount of moisture from the glass fibers, a stack of glass fabric was heated in a circulating-air oven for 1 hr. at 230° F. immediately prior to resin impregnation.

Preparation of polyester and diallyl phthalate laminates

Panels containing polyester and diallyl phthalate were made by the wet lay-up technique. A small amount of resin, previously catalyzed, was spread over the lower platen of the partially assembled mold. A ply of glass fabric was removed from the oven and laid into the resin. Additional resin was spread over the fabric and the process continued, rotating each ply of cloth 90 degrees with respect to the preceding one, until 12 plies of cloth and sufficient resin to produce a laminate containing 50% resin by weight had been introduced into the mold. Each ply surface consisting mainly of fill yarns was placed down against the warp-containing sur-

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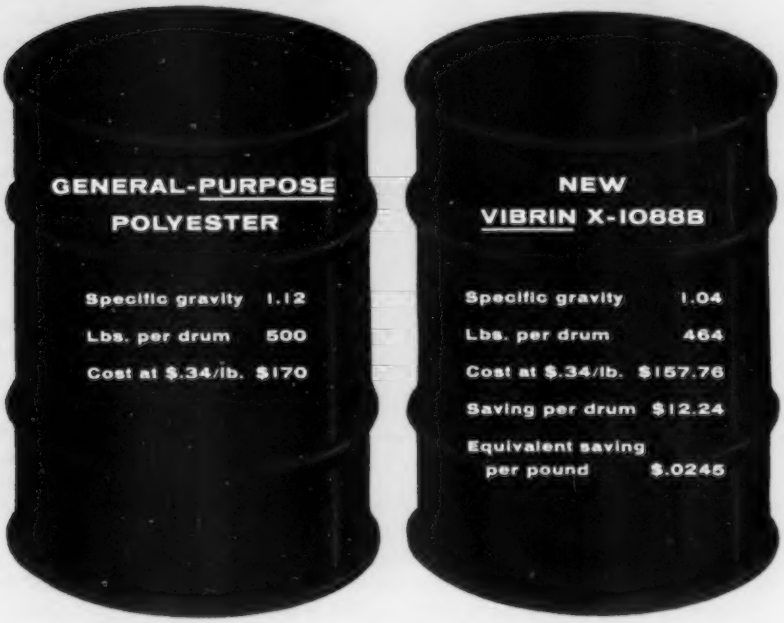

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Table II: Molding compounds evaluated for erosion resistance. (All compounds fabricated in a closed mold for 6 min. at 310° F.)

Sample number	*Filler (as received)*	*Molding pressure*
		p.s.i.
	Melamine	
A-7	Cellulose	2000
A-8	Wood flour	2000
A-9	Wood flour	2000
A-10	Cotton rag	3000
A-11	Cotton rag	3000
A-12	Chopped glass fiber	3000
X-1	Chopped glass fiber	2000
X-2	Macerated cotton fabric	3000
	Phenolic	
F-2	Nylon flock	2000
F-3	Chopped glass roving	3000
W-1	Rag and cord	3000
W-2	Rag and cord	3000
X-3	Fiber	3000
X-4	Cotton fabric, chopped	3000
X-5	Cotton fabric, chopped	3000
X-6	Cotton fabric, chopped	3000
X-7	Cord	3000
X-8	Macerated cotton fabric	3000
X-9	Asbestos fiber	3000
X-10	Chopped glass fiber	1000
X-11	Chopped glass fiber	1000
X-12	Chopped glass fiber	1000

face of the previous ply so that the finished laminate had a top surface containing warp yarns and a bottom surface containing fill yarns. The assembled mold was placed into a 50-ton capacity hydraulic press, and a pressure of 50 p.s.i. was applied. Pressure was maintained for a 10-min. period at room temperature to allow the resin to flow throughout the mold and wet the fibers. The mold was then heated to the desired curing temperature and the pressure was maintained until the resin was cured. The laminates were cooled to room temperature under pressure before being taken out of the mold. Table I shows the molding temperatures and pressures and the amounts and type of catalyst used for each of the materials.

Preparation of phenolic laminates

All of the phenolic resins may be diluted to lower solids to reduce the resin content and increase the strength properties. In this program, however, it seemed more important to coat the glass fibers as heavily as possible to protect the fibers for a longer period of time against the erosive action of water on the laminates. However, G-2 was a very high viscosity resin which had to be diluted in order to be handled properly; 30 parts of 95% ethyl alcohol were added to every 100 parts of resin used.

Twelve plies of glass fabric were individually coated by dipping each ply into a resin bath, and pulling the cloth through steel rollers to remove the excess resin and spread the remainder as evenly as possible over the material. To obtain an even coating of resin and at the same time obtain maximum resin pick-up on the glass, the steel rollers were spaced about 18-20 mils apart.

The impregnated fabric was placed in a circulating-air oven to reduce the percentage of volatiles and to advance the resin to the partially cured or B-stage. The oven temperature was maintained at 266 to 275° F. for all samples, except C-4, which was dried at 239 to 248° F. All were dried for 11 min., except V-1, which remained in the oven for 14 minutes. The volatile content was reduced to the point suggested by the individual manufacturers, generally below 8%, so that the amount of resin flowing out of the laminate during the molding cycle was about 3% or less. The 12 plies of fabric were trimmed to about 10½ by 11½ in. and assembled.

The mold was used without the chase and molding stops to make these laminates. Molding procedures are given in Table I.

Preparation of epoxy laminates

The epoxy laminates were also made by preimpregnating the glass cloth. This procedure, similar to that used for the polyester laminates, consisted of applying the epoxy resin (T-2), previously catalyzed, to the glass cloth, assembling the entire 12-ply lay-up, and allowing it to cure to the B-stage at room temperature for approximately 20 hr. prior to molding. These laminates were also fabricated in the open mold using procedures described in Table I.

Preparation of panels from molding compounds

The phenolic and melamine molding compounds were received as bulk fillers preimpregnated with resin. An amount of molding compound sufficient to produce a ⅛-in. thick panel was poured into the mold, which had been preheated to about 300° F. The full molding pressure was applied immediately and then completely released and reapplied several times to allow gases to escape. After the final application of the molding pressure, the laminates were cured at 310° F. for 6 min. at the pressures indicated in Table II.

Test methods and procedures

Flexural strength and specific gravity were determined in accordance with Methods 1031 and 5011, respectively, of Federal Specification L-P-406b(1).

Flexural specimens were approximately 4 in. long and ⅛-in. thick and were machined to a

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width of 0.500 ± 0.004 in. Flexural strengths of both wet and dry specimens were determined. The dry specimens were tested after a minimum conditioning period of 7 days at 73.4 ± 2° F. and 50 ± 4% relative humidity. The wet strength was determined on specimens which had been immersed in water for 30 ± 1 days at 73.4 ± 2° F. These were removed from the water, wiped dry with absorbent tissue, and tested immediately.

All of the flexural tests were

Table III: Average physical properties of glass fabric reinforced panels made with phenolic, diallyl phthalate, epoxy, and polyester resins

Sample number	Thickness	Flexural strength — Dry		Flexural strength — Wet		Change[b]	Specific gravity	Resin content[c]
		L[a]	C[a]	L[a]	C[a]			
	in.	10^3 p.s.i.	10^3 p.s.i.	10^3 p.s.i.	10^3 p.s.i.	%		wt. %
Phenolic Resins[d]								
C-2	0.141	44.3	42.3	47.6	47.0	+ 9.2	1.72	39.4
C-3	0.134	56.1	52.0	59.8	55.0	+ 6.2	1.77	39.9
C-4	0.094	66.2	67.2	60.6	54.8	−13.4	1.93	23.5
F-1	0.140	35.2	36.3	33.5	33.2	− 6.6	1.70	41.5
G-2	0.147	57.0	53.9	55.4	50.8	− 4.3	1.70	33.4
P-4	0.130	71.9	64.3	63.3	60.4	− 9.0	1.76	38.8
V-1	0.108	81.1	70.6	87.9	71.6	+ 5.1	1.89	33.7
Epoxy Resin								
T-2	0.247	44.8	44.8	44.3	44.4	− 1.0	1.50	62.3
Diallyl Phthalate Resins								
M-1	0.156	56.3	57.0	53.7	53.3	− 5.6	1.72	48.0
T-1	0.158	31.3	33.6	28.7	29.5	−10.2	1.70	48.4
Polyester Resins[d]								
A-2	0.165	53.7	49.7	43.3	44.0	−15.2	1.67	49.7
A-3	0.156	61.0	54.0	50.7	49.3	−12.8	1.70	47.7
A-4	0.153	60.6	61.5	56.3	55.6	− 8.4	1.71	46.6
A-5	0.159	56.5	55.2	45.7	48.6	−15.6	1.69	47.7
B-1	0.161	61.8	58.6	55.9	53.6	− 9.0	1.73	49.9
C-1	0.164	56.2	58.0	53.3	54.6	− 5.6	1.66	48.5
D-1	0.159	51.4	45.3	44.1	42.9	− 9.8	1.76	50.3
D-2	0.163	58.6	57.4	54.4	50.2	−10.2	1.67	48.8
D-3	0.161	59.8	57.4	52.4	51.0	−11.8	1.67	48.2
E-1	0.151	66.2	60.2	57.9	55.3	−10.3	1.71	46.0
G-1	0.164	54.8	55.6	50.1	52.7	− 7.9	1.66	49.0
H-1	0.166	54.1	53.9	49.1	47.6	−10.4	1.67	49.6
J-1	0.159	60.7	60.0	57.2	56.8	− 5.6	1.79	50.8
J-2	0.155	63.8	60.8	58.2	54.7	− 9.4	1.82	50.6
K-1	0.164	58.4	57.9	58.7	55.8	− 1.6	1.68	49.3
K-2	0.165	54.8	53.1	50.4	47.9	− 8.9	1.68	49.4
K-3	0.164	58.5	55.4	55.3	53.3	− 4.6	1.68	49.2
K-4	0.167	57.8	53.9	50.5	49.1	−10.8	1.67	49.9
K-5	0.154	60.8	60.2	54.3	57.7	− 7.4	1.78	49.6
K-6	0.156	57.4	57.4	52.5	56.0	− 5.4	1.74	50.8
K-7	0.161	58.2	58.2	50.4	49.1	−14.5	1.67	48.2
L-1	0.165	57.1	51.6	53.3	49.4	− 5.4	1.68	49.4
L-2	0.166	55.0	54.6	51.0	49.1	− 8.7	1.66	49.8
L-3	0.167	60.8	57.2	58.6	52.8	− 5.6	1.66	49.7
N-1	0.165	51.5	50.5	43.8	42.3	−15.6	1.65	48.9
P-1	0.152	60.3	57.5	55.7	51.6	− 9.0	1.71	45.9
P-2	0.155	60.2	58.8	56.6	53.1	− 7.8	1.69	46.8
P-3	0.156	43.3	42.5	33.5	33.8	−21.6	1.71	48.2
R-1	0.168	58.3	56.3	54.9	50.7	− 7.8	1.66	49.9
R-2	0.164	56.2	55.0	49.9	47.2	−12.7	1.68	49.5
R-3	0.168	53.8	54.5	52.1	53.0	− 3.0	1.64	49.7
S-1	0.163	59.7	59.0	55.6	56.1	− 5.9	1.68	49.4

[a] L=lengthwise direction; C=crosswise direction.
[b] Percent change in flexural strength after 30 days' immersion in water, calculated as follows: [(L+C) Wet − (L+C) Dry/ (L+C) Dry] × 100
[c] Does not include volatile finish on glass which is usually about 0.17% of the weight of the glass fiber.
[d] Standard error of individual averages for flexural strength, in 10^3 p.s.i.: phenolic laminates, dry 2.3, wet 0.9; polyester laminates, dry 1.1, wet 1.2.

made on a universal hydraulic testing machine using a rate of crosshead motion of 0.05 in./min. and a span-depth ratio of 16:1, except for Sample T-2 which was tested at a span-depth ratio of 8:1 because of the specimen thickness.

Analysis of total volatile content and resin content were made on panels containing glass fiber in accordance with paragraph 4.2.2.1.2 of Military Specification MIL-P-8013a(2). This method requires ignition of a specimen to constant weight at 1050 ± 50° F. to obtain the total volatile content. The original weight of the specimens is obtained after storage for at least 4 days under standard conditions for plastics (73.4° F. and 50% R.H.). Resin content is obtained by correcting for the amount of volatile fiber finish on the glass fiber. Ignition of specimens containing organic fillers would not provide comparable data, since fillers as well as resins would be pyrolyzed.

The detergent used in the decontamination treatment complied with Federal Specification P-D-425a (3) for Type II; the concentration used was 0.35 oz./gal. of water. The specimens were washed by a spray from a rotating agitator and were never submerged. Test specimens were attached to the inside of a cylinder of ¼-in. mesh screen wire and was then placed approximately 7 in. from the water spray source, which washed along the length of the 1½- by 3-in. piece of laminate.

The average water temperature at the start was 136.5 to 143.5° F., cooling to 129 to 131° F. during the 4½-min. washing cycle. A 30-sec. pre-rinse at 140 to 143.5° F. followed, and finally a 4-min. rinse, which began at 203 to 212° F., quickly cooled to 176 to 183° F. and was about 167° F. at the end of the rinse. After each cycle had been completed, the specimens were allowed to dry for a minimum of 10 minutes. Fifty exposures to the detergent solution-rinse cycle constituted the complete test.

Flexural strength

The flexural strength data are reported in Tables III, p. 140, and IV, below. An analysis of variance was made on the data obtained for each type of resin or molding compound that contained more than two samples. The following properties were evaluated for each type of material: a) the variability between samples belonging to the same type; b) the variation between laminates within a sample, where 2 low-pressure or 4 high-pressure laminates were used; and c) the dry-wet strength correlation. The effect of specimen direction was also evaluated in the polyester and phenolic laminates.

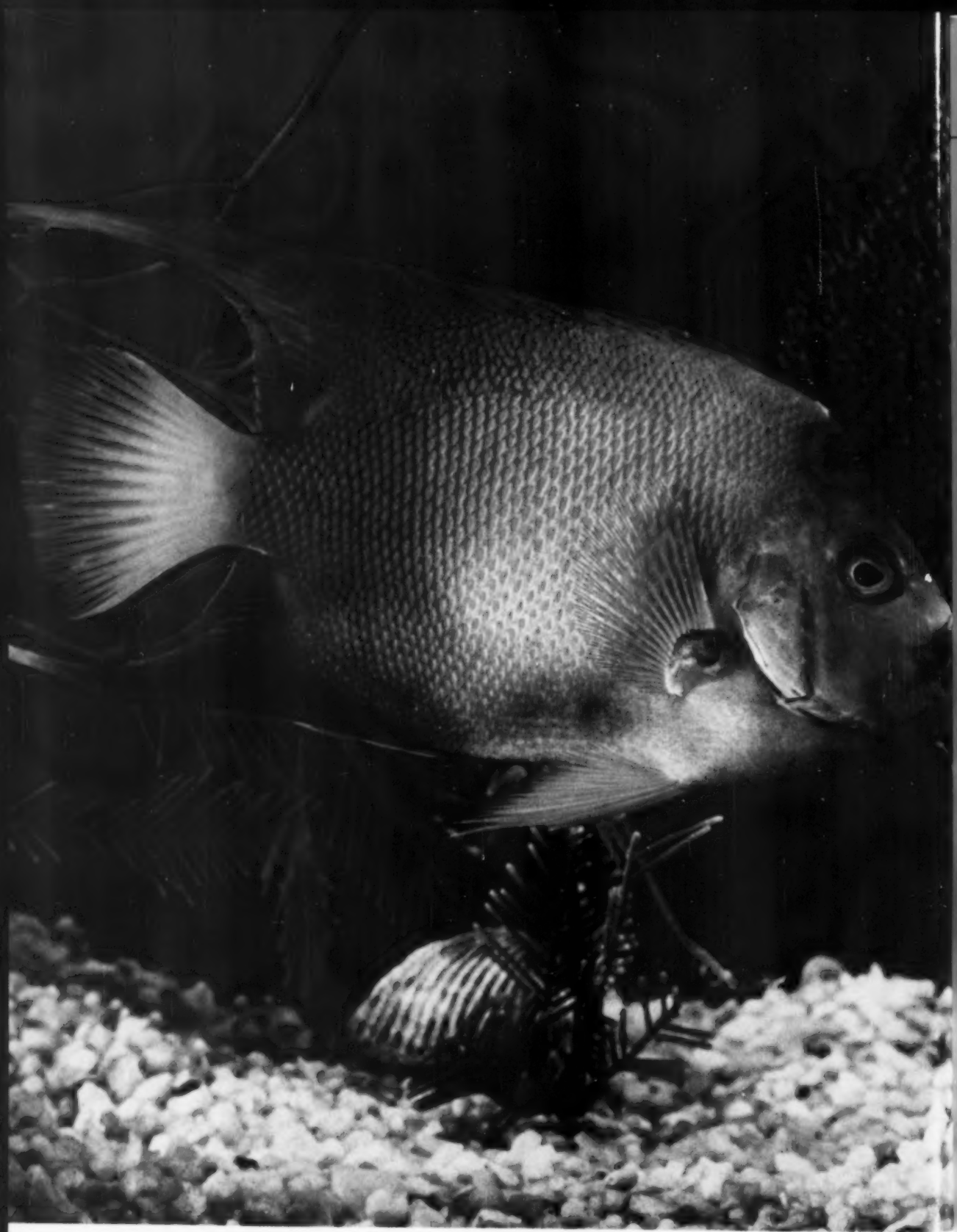
The analysis indicated that the variation between samples, within a type, was, in all cases, significant at the 5% level of signifi-

(*To page* 145)

Table IV: Average physical properties of panels fabricated from molding powders

Sample number	*Thickness*	*Flexural strength*			*Specific gravity*	*Resin content*[b]
		Dry	*Wet*	*Change*[a]		
	in.	*10^3 p.s.i.*	*10^3 p.s.i.*	*%*		*wt. %*
			Melamine[c]			
A-7	0.116	18.4	15.8	−14.1	1.50	—
A-8	0.126	13.5	11.8	−12.6	1.42	—
A-9	0.127	10.1	8.9	−10.9	1.42	—
A-10	0.119	16.2	15.7	− 3.1	1.50	—
A-11	0.122	15.7	15.4	− 1.9	1.47	—
A-12	0.121	10.1	9.2	− 8.9	1.95	41.6
X-1	0.106	7.0	6.0	−14.3	1.97	45.4
X-2	0.128	17.2	17.4	+ 1.2	1.55	—
			Phenolic[c]			
F-2	0.146	14.6	15.9	+ 8.9	1.24	—
F-3	0.117	14.2	15.3	+ 7.7	1.89	40.3
W-1	0.129	12.3	10.8	−12.2	1.36	—
W-2	0.129	10.4	8.6	−17.3	1.36	—
X-3	0.120	11.1	7.1	−36.0	1.37	—
X-4	0.127	12.4	9.8	−21.0	1.38	—
X-5	0.124	11.1	10.0	− 9.9	1.38	—
X-6	0.126	13.3	11.7	−12.0	1.40	—
X-7	0.126	12.3	9.6	−22.0	1.38	—
X-8	0.129	13.8	12.1	−12.3	1.37	—
X-9	0.125	16.5	13.3	−19.4	1.65	—
X-10	0.125	10.4	12.1	+16.3	1.70	47.5
X-11	0.129	14.7	15.3	+ 4.1	1.72	46.9
X-12	0.126	18.1	17.3	− 4.4	1.74	45.5

[a] Percentage change in flexural strength after 30 days' immersion in water, calculated as follows: [(Wet-Dry) ÷ (Dry)] × 100. [b] Not corrected for fiber finish. Information on amount of such finishes on the glass fibers was not available. [c] Standard error of individual averages for flexural strength, in 10^3 p.s.i.: melamine panels, dry 0.7, wet 0.8; phenolic panels, dry 0.8, wet 0.4.



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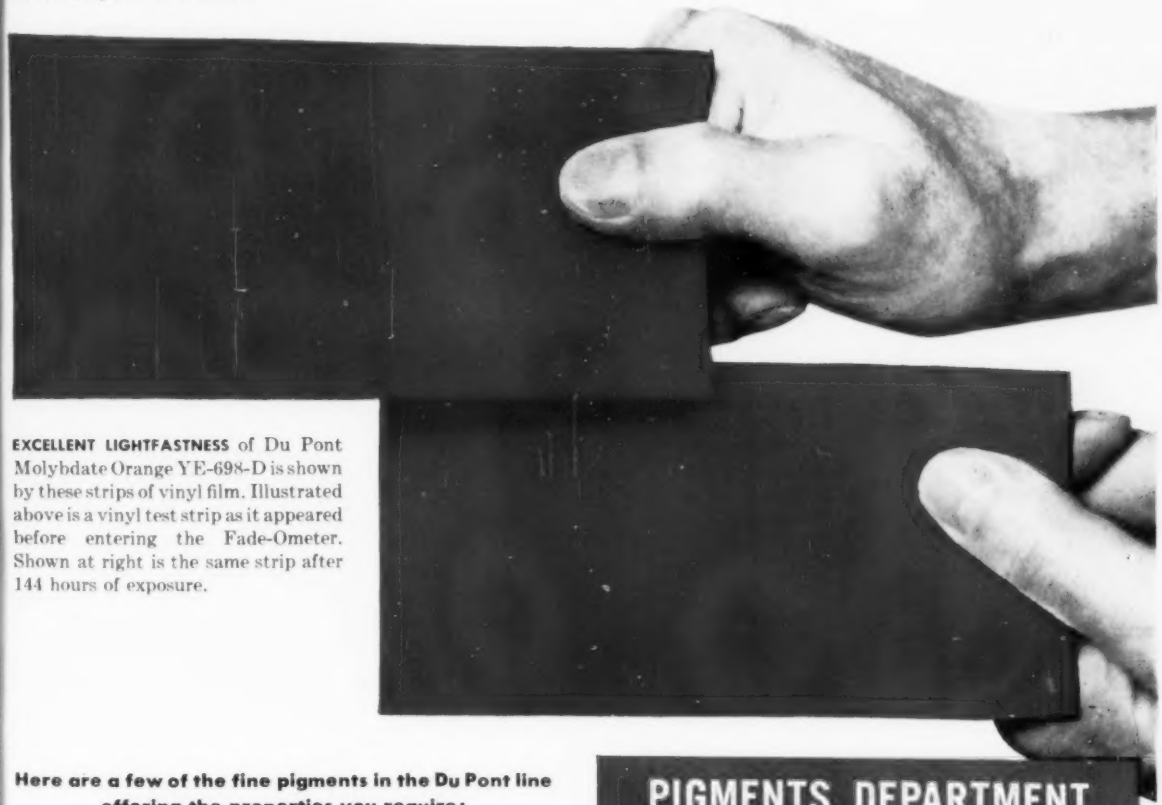

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Table V: Effects of 50 washing cycles on the color of plastic panels

Sample number	*Specimen type*[a]	*Munsell code*	*ISCC-NBS color designation*	*Remarks*
			Melamine molding compounds	
A-7	C/T	2.5G8/2	Very pale green	
A-8	C	2.5Y3.6/4	Moderate olive brown	
A-8	T	2.5Y4/4	Moderate olive brown	Slightly bleached
A-9	C	10.0YR3/2	Dark grayish yellowish brown	
A-9	T	2.5YR5/2	Light grayish reddish brown	Bleached
A-10	C	8.5N	White	
A-10	T	9.0N	White	
A-11	C	10.0YR5.6/4.4	Light yellowish brown	
A-11	T	10.0YR5/6	Strong yellowish brown	Darkened
A-12	C	9.0N	White	
A-12	T	9.5N	White	
X-1	C/T	5.0N	Medium gray	
X-2	C/T	7.5YR5.4/4	Light brown	Numerous white patches from surface fibers
			Phenolic molding compounds	
F-2	C	10.0YR6/4	Light yellowish brown	
F-2	T	10.0YR5/6	Strong yellowish brown	Darkened
F-3	C	7.5YR4/4	Moderate brown	
F-3	T	2.5YR3/6	Strong brown	Darkened
W-1	C/T	1.0N	Black	White patches from filler appeared on specimen surfaces
W-2	C/T	1.0N	Black	Cord appeared to have swollen and broken through surface
X-3	C	10.0YR5/6	Strong yellowish brown	
X-3	T	7.5YR5/8	Strong yellowish brown	Darkened appreciably
X-4	C	10.0YR5/6	Strong yellowish brown	
X-4	T	2.5YR4/4	Moderate reddish brown	Bleached
X-5	C/T	10.0YR3.6/2	Grayish yellowish brown	Slightly bleached, surface fibers much more apparent
X-6	C	4.0YR3/2	Grayish brown	
X-6	T	5.0YR2/2	Dark grayish brown	Darkened, surface fibers more apparent
X-7	C/T	1.0N	Black	Fibers, especially tire cord, appeared to protrude from surface
X-8	C	5.0YR3/2	Grayish brown	
X-8	T	7.5YR3/2	Grayish brown	Darkened slightly, surface fibers much more apparent
X-9	C	2.5Y5/6	Light olive brown	
X-9	T	10.0YR5/6	Strong yellowish brown	Darkened appreciably
X-10	C	10.0R3/4	Moderate reddish brown	
X-10	T	7.5R2/4	Dark reddish brown	Darkened
X-11	C	5.0Y6/8	Dark yellow	
X-11	T	2.5Y5/6	Light olive brown	Darkened appreciably
X-12	C	2.5YR2/3.2	Dark reddish brown	
X-12	T	2.5YR2/2	Dark grayish reddish brown	Slightly darkened, surface fibers more apparent
			Phenolic-glass fabric laminates	
C-2	C	2.5YR4/6	Strong brown	
C-2	T	2.5YR3/6	Strong brown	
C-3	C	2.5Y6/6	Dark yellow	
C-3	T	10.0YR5/8	Strong yellow brown	Darkened
C-4	C	2.5Y5/4	Light olive brown	
C-4	T	10.0YR5/6	Strong yellowish brown	Surface badly eroded
F-1	C	2.5Y5/6	Light olive brown	
F-1	T	10.0YR5/8	Strong yellowish brown	Slightly darkened
G-2	C	2.5Y5.6/6	Dark yellow	
G-2	T	2.5Y6/6	Dark yellow	Resin appeared to be slightly eroded
P-4	C	2.5YR3/6	Strong brown	
P-4	T	5.0YR4/4	Moderate brown	Slightly bleached
V-1	C/T	2.5YR3/6	Strong brown	
			Epoxy glass-fabric laminate	
T-2	C/T	7.5YR1/2	Dark brown	

[a] C=control specimen; T=test specimen; C/T=same Munsell and ISCC-NBS color designation for both control and test specimens.

cance or better. This is attributed to a variety of fillers, in the case of the molding compounds, and to variations in the physical and chemical properties of the low-pressure laminating resins and of the resins in the molding compounds.

The dry-wet strength correlation was obtained by numerically ranking samples, within a type, by both dry and wet flexural strength and comparing their variations. If the correlation is perfect, a sample will have the same numerical rank for both dry and wet strength. This correlation was very good for all samples and all types of materials, indicating that the conclusions drawn for sample-to-sample variability are the same when considered either by dry or wet strength. Rank correlation values were as follows: 0.85 for the polyesters; 0.94 for the phenolic resins; 0.90 for the melamine molding compounds; and 1.00 for the phenolic molding compounds. The variation in flexural strength with regard to specimen direction was found to be small, though significant, at the 5% level of significance for both the polyester and phenolic resins. When all of the samples in each type were considered as a whole, the lengthwise specimens had higher flexural strengths than the crosswise specimens. This variation cannot be readily explained since the laminating procedures were designed to eliminate this variable.

Color changes

The test specimens were compared with controls obtained from the same panels for visible changes resulting from exposure to the decontamination procedure. The Munsell and ISCC-NBS color designations (4) are listed in Table V, opposite, for the molding compounds, and phenolic and epoxy laminates before and after the cycling exposure. All of the molding compounds were obtained in their natural colors, that is, the color produced by the resin and filler without the addition of coloring agents with the possible exception of Samples W-1 and W-2. Colors ranged from white to black; the majority were brown. The combination of glossy surface, white spots due to the presence of superficial fibers, and occasional mottling, made exact determinations extremely difficult. The phenolic and epoxy laminates were also completely opaque, the colors varying from light to dark brown.

The color of the individual polyester specimens was not determined since the combined effects of translucency and the pattern effect of the glass fabric, particularly in the exposed specimens made objective determinations nearly impossible. The combined optical properties of the resins and glass fiber produce a green color, which is best classified as falling within the Munsell range of 5.0 GY5/10 to GY5/4 (ISCC-NBS color designation—light to moderate yellow green). Normally the lightest coloring was observed in the most opaque specimens and the darkest coloring in the most transparent specimens.

Light transmission

Table VI, below, summarizes changes in light transmission of the polyester and diallyl phthalate

Table VI: Effects of the washing cycle tests on the light transmission of the polyester and diallyl phthalate laminates[a]

Sample number	*Control specimen*	*Test specimen*
	Polyester Resins	
A-2	Moderately opaque	Opaque
A-3	Slightly opaque	Moderately opaque
A-4	Transparent	Slightly opaque
A-5	Transparent	Translucent
B-1	Moderately opaque	Opaque
C-1	Slightly opaque	Moderately opaque
D-1[b]	Opaque	Opaque
D-2	Transparent	Slightly opaque
D-3	Moderately opaque	Opaque
E-1	Semi-transparent	Opaque
G-1	Transparent	Semi-transparent
H-1	Opaque	Opaque
J-1	Transparent	Translucent
J-2	Semi-transparent	Slightly opaque
K-1	Transparent	Opaque
K-2	Moderately opaque	Opaque
K-3	Transparent	Translucent
K-4	Semi-transparent	Moderately opaque
K-5	Transparent	Semi-transparent
K-6	Transparent	Transparent
K-7	Slightly opaque	Opaque
L-1	Moderately opaque	Opaque
L-2	Semi-transparent	Moderately opaque
L-3	Transparent	Moderately opaque
N-1	Opaque	Opaque
P-1	Transparent	Semi-transparent
P-2	Semi-transparent	Slightly opaque
P-3	Opaque	Opaque
R-1	Slightly opaque	Opaque
R-2	Opaque	Opaque
R-3	Slightly opaque	Moderately opaque
S-1	Transparent	Moderately opaque
	Diallyl Phthalate	
M-1	Slightly opaque	Moderately opaque
T-1	Slightly opaque	Moderately opaque

[a] The specimens are rated on the ability to read typewritten material through them when they were laid flat on a white background, as follows: Transparent: print could be read easily and rapidly, with no distortion; Semi-transparent: some distortion but print could still be read easily; Translucent: print could be read with some difficulty due either to distortion or to the appearance of white spots on the surfaces from exposure of the glass fibers; Slightly opaque: print could be identified as such but individual letters often could not be identified; Moderately opaque: print appeared as blurred lines; Opaque: nothing seen through the specimen. [b] Contained diallyl phthalate monomer.

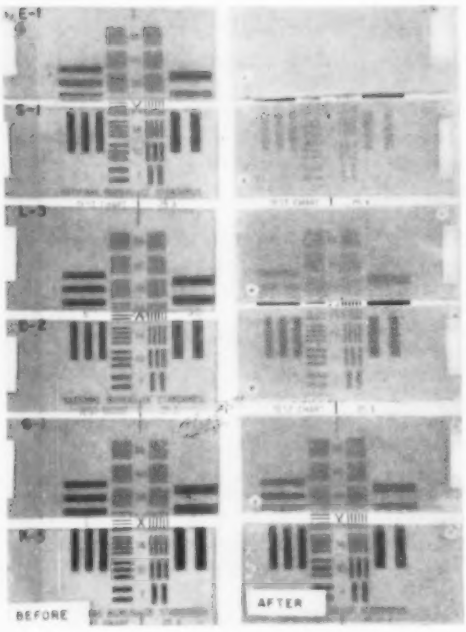


Fig. 1: Optical properties of polyester-glass fabric laminates "before" and "after" exposure to 50 washing and drying cycles. Specimens are resting on an NBS resolution chart and are illuminated from above

laminates before and after cycling. In almost every case, the effect of the wetting and drying was an increase in opacity of the exposed specimen as compared to a control. Four of the samples, D-1, H-1, N-1, and P-3, were classified as opaque both before and after washing. However, all of the test specimens from these samples appeared more white after the exposures, indicating some effect of the tests. One sample, K-6, was classified as transparent both before and after the tests, but the washed specimen had begun to show small white spots at points in the surface where the glass fiber apparently was breaking away from or through the surface layer of resin. Figure 1, above, shows the change in opacity caused by the washing cycle on six specimens, each made with a different resin.

The general trend toward increased opacity may be attributable to a number of mechanisms related to the exposure to moisture. For example, erosion of the surface with subsequent exposure of glass fiber could impair the optical properties of the sheet, or the resin could be degraded by the action of the hot water and the detergent. It is also possible that some increase in opacity may be caused by absorption of water in the resin. Sample E-1, which had the greatest increase in opacity of any of the polyesters, exhibited relatively small structural surface changes when examined with a high-powered microscope. On the other hand, Sample K-6, which lost least transparency not only developed a moderate amount of surface cracking but was also covered with craze cracks. Microscopic examination of specimens with decreased transparency revealed embedded yarns with numerous, apparently highly refractive fibers. Failure in the adhesive bonds between fiber and resin created many fine discontinuities which decrease light transmission. It would appear that the primary cause of this change in appearance is due to inadequate resin-fiber adhesion.

Surface structure

The effects of the wetting-drying cycles on the surface structure of the specimens were determined by means of microscopic examination. Direct observation of the surfaces is difficult since the incident light penetrates the superficial layers of resin on the surface of the specimen. To resolve the surface details more clearly, thick plastic replicas of the surfaces were made with collodion. A solution of USP collodion in amyl acetate (1:1) was allowed to flow over the specimen surface. After drying, the replicas were stripped from the specimens onto a water surface and placed on a glass slide. The replicas were shadowed with silver as recommended by Wyckoff (5) for optical microscopy. The replicas made both before and after the moisture cycling were examined at magnifications from 35X to 600X in a universal microscope equipped with devices for vertical and oblique illumination. The effects of replication were checked on all specimens by examination before application and after removal of the replicating material. Structural changes were also studied by depositing reflective coatings directly on the laminate specimens and examining the surfaces by incident illumination.

The original finished surface of all of the low-pressure laminates reflected the structure of the glass fiber style 181 laminating fabric. Figure 2, p. 148, shows the fabric face adjacent to the surface in the top ply. In this orientation each warp goes under one fill yarn and over the next seven fill yarns. The weave is staggered so that adjacent warp yarns are two additional fill yarns out of register. Replicas of the original laminate surface contain a pattern of the fabric as shown in Fig. 3, p. 148. At the apex of the warp yarn passing over the fill yarns, some fibers intersect the surface and result in relief impressions of the fibers in the surface resin. In some cases the thin covering of resin had cracked along the length of one or more of these apical fibers. During the molding process the press platens are applying a large part of the compressive force to the glass fabric. The outermost projections from the laminates are squeezed free of resin and, as the polyester shrinks and contracts on curing, the glass fibers of the warp yarns remain in the surface. In this sense the statement (6) is true that glass fiber used in reinforcing resins comes to the surface during curing.

After the wetting and drying exposure, cracking appeared at the sites of the yarn apices as shown in Fig. 4, p. 148. This type

of surface failure occurred in almost all of the samples tested although the severity varied from resin to resin. Examination of the surfaces revealed that the cracking involved more than one fiber at each apex. In most of the samples the cracking was concentrated at the yarn apices. When the stress was relieved at these points the crack showed no tendency to spread further. In Fig. 5, below, however, the cracks observed are not so localized. This sample (D-1) exhibited a number of cracks even before exposure to wetting and drying. After decontamination the cracks were found to be greatly elongated. As the long cracks approached yarn apices near their

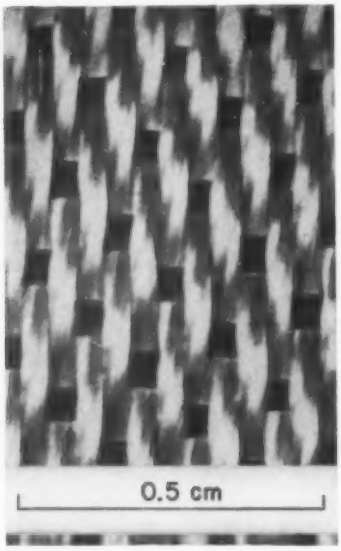


Fig. 2: Surface of Type 181 glass fabric used with low molding pressure resins. Photographed by glazing-incidence reflected illumination. Fill yarns do not reflect and so appear dark

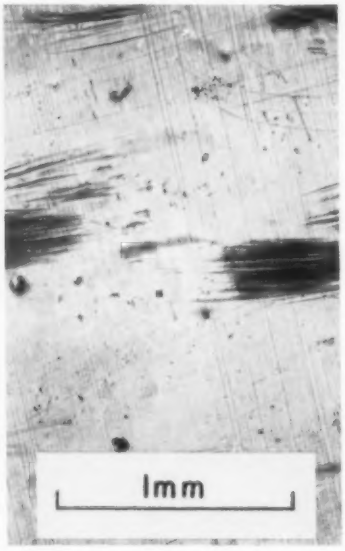


Fig. 3: Photomicrograph of the surface of a glass fabric polyester laminate (J-2). A layer of silver was deposited vertically on the surface. Vertical-incidence illumination was used

Fig. 4: Collodion replica of the surface of laminate A-2 after 50 cycles of washing and drying, silver shadowed 4:1. Deep cracks have formed along fibers at each yarn apex

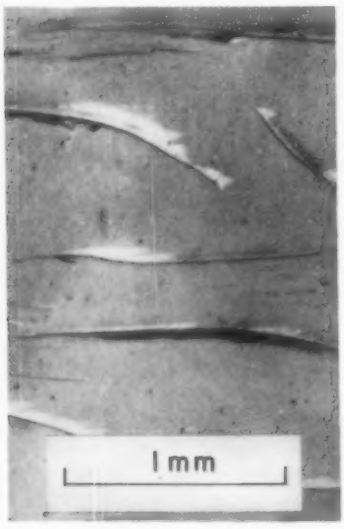


Fig. 5: Collodion replica of laminate D-1 surface after 50 cycles of washing and drying, silver shadowed 4:1. Exposure caused long cracks, which curve into adjacent yarn apices

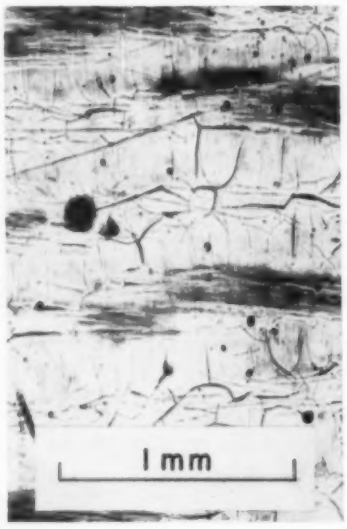


Fig. 6: Severely crazed surface of laminate K-5 after 50 cycles of washing and drying, under vertical-incidence illumination. A layer of silver was deposited on the surface in vacuo

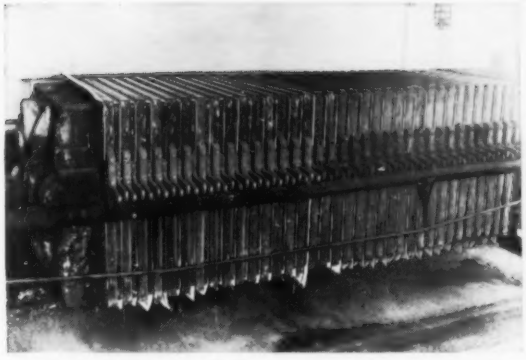
Fig. 7: Collodion replica of the surface of a glass fabric phenolic laminate (C-2), silver shadowed 4:1. The depressions in the surface are formed where warp yarns pass under fill yarns

CYANAMID

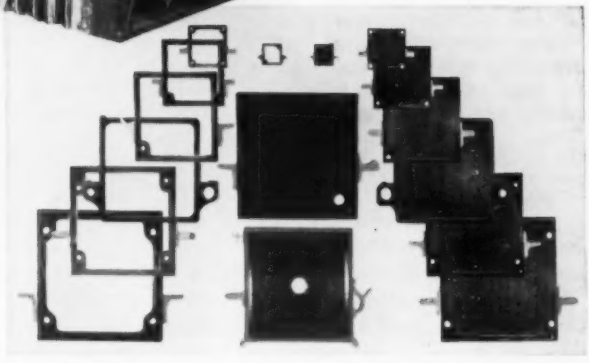
CORROSIONEERING WITH LAMINAC®

POLYESTER RESIN

THINNER, STRONGER LAMINAC plastic plates and frames provide greater filtering area and cake capacity than wood in filter presses.



LAMINAC HOLDS CLOSE TOLERANCES when ground, makes a perfect watertight seal when plates and frames are compressed between filter press heads.



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Reinforced LAMINAC filter plates and frames raise capacity up to 70%, cost less, last longer!

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Fig. 8: Collodion replica of a glass fabric phenolic laminate (C-2) surface after 50 cycles of washing and drying, silver shadowed 4:1. Much of the surface is covered with glass fiber

Fig. 9: Surface of a glass fabric phenolic laminate (C-4) after 50 cycles of washing and drying. A layer of silver was deposited and illumination was vertical-incidence

Fig. 10: Collodion replica of molded panel A-12 after 50 cycles of washing and drying, silver shadowed 4:1. Deep jagged cracks can be seen intersecting a superficial glass fiber

origin, they curved into these stress fields. This was the only sample containing diallyl phthalate as the crosslinking agent.

The chlorine-containing polyester resins produced a somewhat different type of failure under the stresses produced by wetting and drying. Before cycling there was little or no cracking along the fibers at the yarn apices although one sample (K-6) showed some slight crazing (7) before exposure. After decontamination the fiber impressions were still intact but the resin-rich areas between the yarn apices were severely crazed as in Fig. 6, p. 148. Examination at high magnifications indicates that the resolvable craze cracks stop at the borders of the glass rich areas. For the most part the crazing is unoriented, but one sample showed some preferred orientation with a system of cracks running from one glass-rich area to another in the same plane. All of the crazed polyesters had chlorine contents ranging upward from 25 percent. Sample K-4, which did not exhibit general crazing over the surface, developed a network of branched shallow fissures at the crack ends. The lack of orientation and the superficial nature of the failures bore a great resemblance to the more complex system of crazing noted in Samples J-1, J-2, K-5, and K-6.

It is obvious from the gross appearance observations that crazing results in less serious loss of optical properties than is caused by surface cracking and loss in resin-fiber adhesion. Craze cracks are quite shallow but nevertheless contribute to surface degradation by opening paths to lower strata in the laminates. The other categories of failure may extend much more deeply and cause more serious changes in the optical path of transmitted light.

The surfaces of the phenolic laminates mirrored the structure of the laminating fabric with greater detail than the polyesters. Probably because of the relatively low resin content the sur-

(*To page* 216)

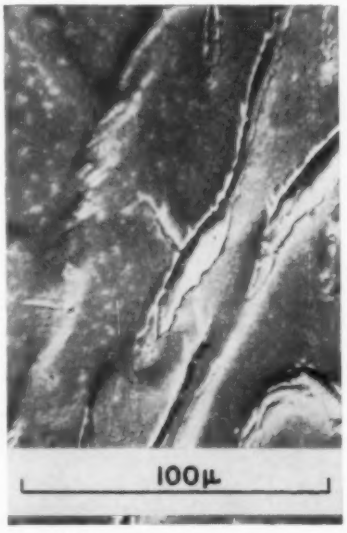
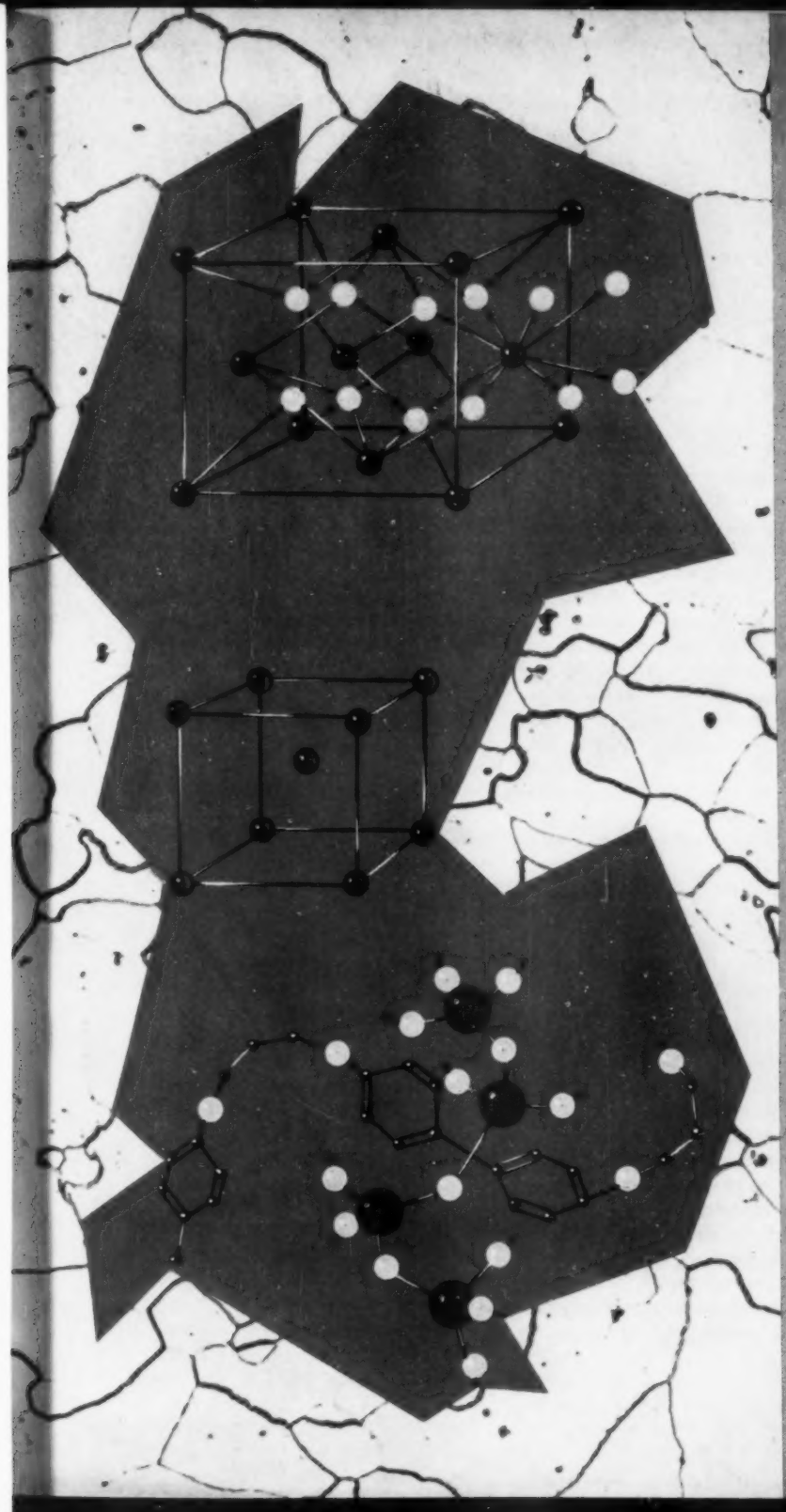


Fig. 11: Collodion replica of molded panel X-7 after 50 cycles of washing and drying, silver shadowed 4:1. Loss of surface resin has bared some of the superficial fiber

Fig. 12: Collodion replica of molded panel X-6 after 50 cycles of washing and drying, silver shadowed 4:1. Many cracks, mostly transverse, are present as a result of the cycling



NEW APPROACH TO "OLD" MATERIALS

By today's standards, the "old" refractory metals are outdated. The ultimate in high-temperature studies of 10 years ago is several generations behind in terms of modern aircraft and missile development.

Today's material requirements surpass anything envisioned 10 short years ago. Molybdenum and beryllium, for example, are still exciting metals with much promise for space vehicles and ultra-high-speed aircraft. It now appears, however, that the full promise of such metals may be fulfilled when they are used, not alone, nor as alloys, but when combined with other materials to form totally new types of structural materials.

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Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

General

Polymerization. A. F. Roche and F. H. Bolton. Ind. Eng. Chem. *50*, 1393-1400 (Sept. 1958). *Fibers.* C. S. Grove, Jr., R. S. Casey, and J. L. Vodonik. Ibid. 1444-48. *Elastomers.* B. S. Garvey, Jr. Ibid. 1438-43. *Plastics.* R. B. Seymour. Ibid. 1470-78. *Protective coatings.* F. Scofield. Ibid. 1478-81. Reviews with 423 references on polymerization, 115 on fibers, 188 on elastomers, 231 on plastics, and 119 on protective coatings.

Materials

Plasticizers for polyvinyl chloride. Properties of the linear tetraesters. E. Nejedly and J. Gottweis. Chem. Prumysl *7*, 438-43 (1957). Several linear saturated tetraesters were tested for solvent power, stability of the polymer-plasticizer system, plasticizing effect, volatility, and low-temperature resistance. These properties are dependent on the structural composition. Optimum properties are displayed by tetraesters with isolated polar carboxyl groups and with chains terminated by four carbon linear aliphatic components.

Synthesis of new polymers with inorganic chains of molecules. K. A. Andrianov and A. A. Zhdanov. J. Polymer Sci. *30*, 513-24 (July 1958). The synthesis of polymers in which the main chain contains silicon, aluminum, or titanium, and oxygen is described.

The new polyethylenes. Part 2. M. W. Riley. Materials in Design Eng. *48*, 96-100 (Aug. 1958). The new polyethylenes (PE) can be formed on standard equipment by injection, compression, or blow molding, and by extrusion. Optimum results are obtained in molds specifically designed for medium density (Type II) and higher density (Type III) materials. Types II and III PE have relatively sharp melting points, which necessitates careful control over the temperature of the melt and the mold to prevent differential cooling and resulting internal stresses. The higher density materials have greater tensile strength and lower permeability to vapors and fluids. These characteristics are very desirable in many fiber applications. Fibers of Types II and III PE have a high degree of toughness, strength, and abrasion resistance. Such fibers are being used in making rope and a variety of textile products.

Fluorocarbon plastics take on new jobs. R. B. Norden. Chem. Eng. *65*, 158, 160, 162 (Aug. 11, 1958). Recent advances in fluorocarbon plastics promise much wider application of these materials. Polytetrafluoroethylene (PTFE) is resistant to all chemicals except molten alkalies, withstands temperatures up to 500° F., has almost zero moisture absorption, high strength, and a low coefficient of friction. However, it does not flow, turning into an amorphous gel above 620° F. A modification has been a copolymer formed by polymerization with hexafluoropropylene. This copolymer softens at 545° F. and is extruded at 650 to 740° F. Except for its inability to withstand extended exposures above 400° F., it has very similar properties to PTFE. Polychlorotrifluoroethylene can be molded or extruded on standard equipment, but is not as resistant as PTFE or its new copolymer to some chemicals, particularly halogenated and aromatic solvents. An electrolytic coating process for PTFE is being developed.

Molding and fabricating

Intensive mixing. W. R. Bolen and R. E. Colwell. SPE J. *14*, 24-28 (Aug. 1958). Intensive mixing is defined as that type of mixing dependent on the degree of shear in the system. The simplified version of an intensive mixer under consideration is typical of the Banbury, screw extruder, and smooth-surface torpedo. The primary object of intensive mixing is the reduction of the size of fillers and colorants, the discontinuous phase, by the action of shearing stresses. The basic intensive mixer is described. Flow correlations and shear stresses are discussed. Mathematical formulas are derived for calculating shearing stresses in the basic mixer.

Best results with phenolic molded parts. D. M. Buchanan. Prod. Eng. *29*, 44-6 (Sept. 1, 1958). The basic rules to be followed when molding phenolics are briefly discussed. Unrestricted flow is required. Proper design must consider shrinkage so that shrinkage will occur evenly. The parting line should be placed where it can be removed easily. The most liberal draft the design will allow should be specified. Stress concentrations at sharp corners should be avoided. Other factors that enter the picture, such as holes, inserts, surfaces, and color, are also discussed.

Applications

Super-thin bonded insulating films. W. K. W. Chen and W. E. Estey. Electrical Mfg. *62*, 84-89, 274 (Aug. 1958). Thin dielectric films that can operate continuously at elevated temperatures are required in the miniaturization of electronic equipment, particularly those that are to be used in high velocity airborne equipment. Polytetrafluoroethylene (PTFE) has a high insulation resistance (10^{15} ohm-cm. at 25° C.) and low dissipation factor (0.01%) and can be formed into

*Reg. U.S. Pat. Off.

films of high dielectric strength. A new composite dielectric material based on PTFE that is suited to the miniaturization of electronic components and permits more economic component manufacturing methods is described. It consists of super-thin films of PTFE bonded to both sides of aluminum foil. Good electrical quality films as thin as 1.5 microns can be produced and handled in normal winding processes. Capacitors about 0.032 cu. in. per microfarad can be wound from such dielectric materials in a single layer. Comparisons to metallized polyester film and to lacquer films are made.

Using plastics in electronics. L. D. Shergalis. Electronic Design *6*, 18-21 (Sept. 3, 1958). The most common electronics application for thermosetting materials is in the fabrication of laminates for printed-wiring boards. Diallyl phthalate plastic is a fairly new material with excellent dielectric strength, good heat resistance, and excellent dimensional stability. Polypropylene is a promising new material with excellent heat resistance. Other thermosetting and thermoplastic materials commonly used in electronics applications are described. A plastics reference chart listing 16 materials and properties such as dielectric constant, moisture resistance, practical temperature limit, dimensional stability, and typical electronic applications is included.

Properties

Torsion oscillations on stretched high polymers. K. H. Hellwege, R. Kaiser, and K. Kuphal. Kolloid Z. *157*, 27-37 (Mar. 1958). The influence of stretching on partly crystalline polyethylene, Teflon, polyamide, and urethane fibers was measured by torsion oscillation. For stretched low-density polyethylene, the quenching maximum disappears at 60° C. A maximum appears at 0° C. due to the amorphous region. From 20 to 86° C. this maximum moved from 0 to 40° C. due to a reduction and change in position of the crystalline regions. The other materials show a change of the

quenching maximum 10 to 30° C. higher after stretching, as is expected for highly stretched noncrystalline areas.

Anelastic creep of polymethyl methacrylate. O. D. Sherby and J. E. Doon. J. Mech. and Phys. Solids *6*, 145-62 (1958). The tensile deformation of polymethyl methacrylate was found over the temperature range 263 to 410° K. to be anelastic; that is, full recovery occurred if sufficient time was allowed. Between 263 and 320° K. the activation energy was independent of the strain but decreased linearly with increase in stress. Above 320° K. the activation energy for creep increased with increasing temperature, and sudden temperature changes induced transients in the creep curves. These transients are attributed to second order phase changes.

Testing

Radiation damage to plastics. D. M. Newell. SPE J. *14*, 17-21 (July 1958). Several plastics, used in weapons systems, were evalulated for their resistance to fast neutron and gamma radiation. Standard methods for physical testing were used to evaluate changes occurring from various dosages and dose rates. No significant changes were detected for the experimental conditions used, for nylon, fiber-reinforced phenolic, a metal adhesive, and a silicone varnish. An acrylic material showed a decrease in optical transmission although the impact strength was not affected. Lower values for ultimate elongation were obtained for silicone rubber, but a sample of polytetrafluoroethylene showed an increase in tensile strength.

Determination of poly (ethyl-esters) in methyl methacrylate copolymers. J. Haslam, J. B. Hamilton and A. R. Jeffa. Analyst *83*, 66-71 (1958). The methyl and ethyl alcohol components of the esters of methyl methacrylate copolymers are removed with hydrogen iodide. The mixed iodides are caught in heptane and diluted with heptane containing methylene dichloride and ethylene dichloride. The solution is passed over dinonyl sebacate on Celite at 75° C. to get a separation by gas chromatography. Internal standards and a calibration curve are used to complete the determination which gives results good to 1 percent.

Publishers' addresses

The Analyst: W. Heffer & Sons, Ltd., Hills Road, Cambridge, England.
Chemical Engineering: McGraw-Hill Digest Publishing Co., Inc., 330 W. 42nd St., New York 36, N. Y.
Chemicky Prumysl: Prumyslove vydavatelstvi, Panska 2, Prague (11) Czechoslovakia.
Electrical Manufacturing: The Gage Publishing Co., 1250 Sixth Ave., New York, N. Y.
Electronic Design: Hayden Publishing Company, Inc., 19 E. 62nd St., New York 21, N. Y.
Industrial and Engineering Chemistry: American Chemical Society, 1155 Sixteenth St., N. W., Washington 6, D. C.
Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N. Y.
Journal of the Mechanics and Physics of Solids: Pergamon Press, 122 E. 55th St., New York 22, N. Y.
Kolloid Zeitschrift: Verlag Dr. Dietrich Steinkopff, Holzhofallee 35, Darmstadt, Germany.
Materials in Design Engineering: Reinhold Publishing Corp., 430 Park Ave., N. Y. 22, N. Y.
Product Engineering: McGraw-Hill Publishing Co., 330 W. 42nd St., New York 36, N. Y.
SPE Journal: Society of Plastics Engineers, Inc., 513 Security Bank Building, Athens, Ohio.—END

U.S. Plastics Patents

Copies of these patents are available from the U.S. Patent Office, Washington, D.C., at 25¢ each.

Polymers. R. G. Arnold, C. L. Kehr and J. J. Verbanc (to Du Pont). U. S. 2,846,416, Aug. 5. Polyalkylene ether polyurethane polymers.

Polymers. C. D. Shacklett (to Du Pont). U. S. 2,846,417, Aug. 5. Terpolymers of N-acrylamidoalkyl betaines.

Polymers. A. Hartman (to Lucius and Bruning). U. S. 2,846,423, Aug. 5. Acrylonitrile polymers.

Copolymerization. G. Mino (to American Cyanamid). U. S. 2,846,424, Aug. 5. Acrylonitrile copolymers.

Resin. L. S. Kohn (to General Electric). U. S. 2,847,341-2-3, Aug. 12. Ethoxyline resin composition.

Polymerization. A. Wheeler (to Du Pont). U. S. 2,847,391, Aug. 12. Polymerization of tetrafluoroethylene.

Resin. S. O. Greenlee (to S. C. Johnson). U. S. 2,847,393-4, Aug. 12. Polyepoxide polyester-phenol-aldehyde compositions.

Resin. R. L. Wear (to Minnesota Mining). U. S. 2,847,395, Aug. 12. Heat-curing epoxy resins.

Resins. L. Sellet. U. S. 2,847,396, Aug. 12. Guanylurea resins.

Condensates. J. Kleine and E. Siggel (to Glanzstoff-Fabriken). U. S. 2,847,397, Aug. 12. Polycondensation of diol esters of aromatic dicarboxylic acids.

Copolymers. E. W. Gluesenkamp and J. D. Calfee (to Monsanto). U. S. 2,847,398, Aug. 12. Vinylene carbonate-ethylene copolymer.

Polymers. S. Melamed (to Rohm & Haas). U. S. 2,847,399, Aug. 12. Polymers of vinyl ethers of substituted biurets.

Polymers. N. M. Bortnick (to Rohm & Haas). U. S. 2,847,400, Aug. 12. Polymers of acrylic derivatives of urea.

Interpolymers. E. W. Gluesenkamp and J. D. Calfee (to Monsanto). U. S. 2,847,401-2, Aug. 12. Interpolymers of vinylene carbonate with halo-substituted ethylenes.

Polymer. L. L. Contois, Jr. (to Monsanto). U. S. 2,847,403, Aug. 12. Polyampholytes from carboxyl-containing polymers.

Copolymer. N. R. Legge (to American Synthetic Rubber). U. S. 2,847,-406, Aug. 12. Cross-linked styrene-divinylbenzene-butadiene copolymer.

Polymers. P. L. de Benneville and M. J. Hurwitz (to Rohm & Haas). U. S. 2,847,409, Aug. 12. Unsaturated aminosilane polymers.

Cellulose derivatives. R. L. Mitchell, R. F. Bampton and W. H. Wadman (to Rayonier). U. S. 2,847,-411, Aug. 12. Production of hydroxy ethoxy cellulose.

Water purifier. J. Bjorksten. U. S. 2,848,389, Aug. 19. Solar still composed of plastic.

Polyethers. H. A. Newey (to Shell). U. S. 2,848,426, Aug. 19. Polyepoxy polyethers.

Cellular plastics. L. C. Rubens (to Dow). U. S. 2,848,427-8, Aug. 19. Cellular plastics from vinyl aromatic resins.

Resins. R. M. Frey and S. F. Shivaga (to McGraw-Edison). U. S. 2,848,430, Aug. 19. Tall oil-phenol-furan resins.

Resins. R. T. Dean and J. P. Manasia (to Interchemical). U. S. 2,848,-431, Aug. 19. Polycarboxylic acid—polymeric polyhydric alcohol resins.

Polyesters. R. M. Schulken, Jr. and J. W. Tamblyn (to Eastman Kodak). U. S. 2,848,432, Aug. 19. Stabilization of polyesters against hydrolysis by adding acrylamide polymer.

Resins. F. R. Eirich (to Aries). U. S. 2,848,433, Aug. 19. Copolymerized and cross-linked epoxide resins.

Hydrosols. R. J. Hellman (to Eastman Kodak). U. S. 2,848,434, Aug. 19. Hydrosols prepared by polymerizing two monomers in the presence of a polymer.

Resins. L. H. Griffin and J. H. Long (to Shell). U. S. 2,848,435, Aug. 19. Epoxy resins.

Resins. R. M. Christenson (to Pittsburgh Plate Glass). U. S. 2,848,436, Aug. 19. Phenolic resins.

Polymers. W. P. Langsdorf, Jr. and G. S. Stamatoff (to Du Pont). U. S. 2,848,437, Aug. 19. Polymerization of formaldehyde.

Resins. E. W. Gluesenkamp (to Monsanto). U. S. 2,848,438, Aug. 19. Amine-formaldehyde resins.

Polyesters. D. D. Reynolds and T. M. Laakso (to Eastman Kodak). U. S. 2,848,439, Aug. 19. Linear polyesters of carboxy-phenyl diamides.

Copolymers. C. W. Davis and F. A. Ehlers (to Dow). U. S. 2,848,440, Aug. 19. Copolymers of vinyl lactams and trimethallyl isocyanurate.

Copolymers. J. F. Svetlik, Sr. (to Phillips). U. S. 2,848,442, Aug. 19. Conjugated diene-heterocyclic nitrogen base copolymers.

Cellular product. G. E. Henning (to Western Electric). U. S. 2,848,-739, Aug. 26. Cellular plastics.

Films. M. F. Bechtold (to Du Pont). U. S. 2,848,752, Aug. 26. Porous open-cell polymer films.

Thermoplastic. R. W. Swinehart, G. K. Greminger, Jr. and M. A. Weaver (to Dow). U. S. 2,849,328, Aug. 26. Water-soluble cellulose ethers.

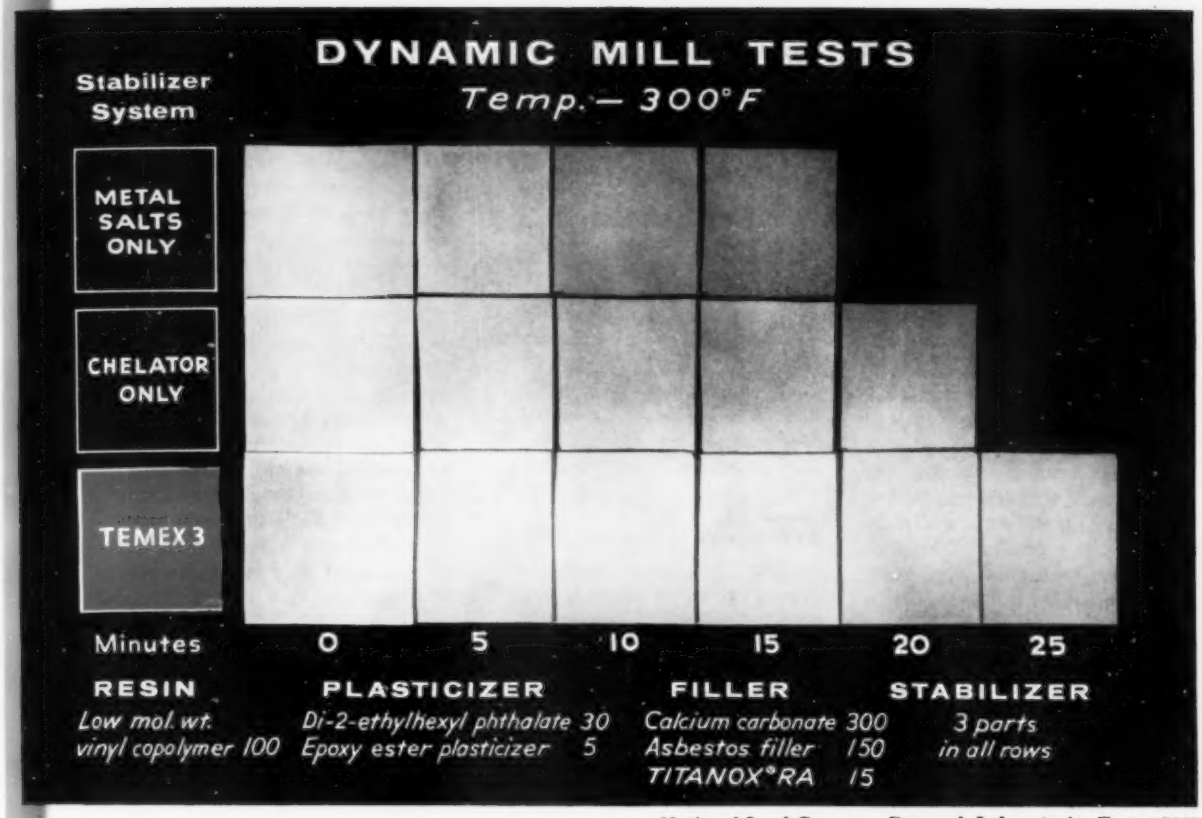
Cellulose derivatives. H. A. Hoffman, Jr. and W. K. Wilkinson (to Du Pont). U. S. 2,849,330, Aug. 26. Composition containing cellulose derivatives.

Composition. L. L. Stott (to Polymer). U. S. 2,849,403, Aug. 26. Nylon polytetrafluoroethylene composition.

Resins. W. Lehmann and O. Bayer (to Bayer). U. S. 2,849,411, Aug. 26. Stabilizing basic epichlorohydrin condensates.

Plasticizer. L. E. Robb and D. R. Wolf (to Minnesota Mining). U. S. 2,849,412, Aug. 26. Plasticizers for vulcanized perfluorochloroolefin polymers.

Resins. L. T. Jenkins and R. R. Holmes (to Chemstrand). U. S. 2,849,413, Aug. 26. Polyacrylonitrile stabilizers.—END



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New Machinery and Equipment*

Scratch resistance tester

The resistance of plastics to surface scratching is important in many applications. The Model 203 scratch/shear tester is designed to measure the load required on a standard diamond point to produce a "standard" scratch. An interchangeable tool with a slightly curved sharp edge can also be used with the instrument to make measurements of the resistance of surfaces to gouging. This measurement will probably correlate with shear strength and is considered a shear test by the instrument maker. A modification of the shear test can be used to test adhesion of coatings and laminates. *Taber Instrument Corp., 111 Goundry St., North Tonawanda, N. Y.*

Pelletizer

The model 400-2 pelletizer is designed to reduce to small uniform lengths extrudates such as filaments, rods, tubes. The balanced rotor has two blades, is ball-bearing mounted. Strands are fed by two feed rolls that are geared to the chopper drive. Resulting pellets need not be screened, are free of fines. The unit, which stands about 5 ft. high, is powered by a ¾-hp., variable-speed drive. Capacity is about 400 lb./hr. Price is $1240. *Al-Be Industries, 6101 Clara St., Bell Gardens, Calif.*

Large metallizer

A 72-in. vacuum coater has six stations that can hold work pieces up to 22 by 50 inches. The pump-down time of the LC1-72 to half a micron is 5.5 min., complete cycle as little as 9 minutes. Operating pressure range is from 0.05 to 2 microns. A planetary drive fixture contains six stations, each of which has six work-holding rods that may be adjusted along the length of each spoke of the station fixture to working diameters of 2 to 20 inches. Cycle is semi-automatically controlled. *Rochester Div., Consolidated Electrodynamics Corp., 300 N. Sierra Madre Villa, Pasadena, Calif.*

Redesigned extruders

A new line of completely redesigned extruders has been introduced. The new machines have been beefed up for long-time operation at 5000 p.s.i. and higher, have L/D ratios of 20:1 on standard models and 24:1 on vented models. A full range of standard and vented machines up to 8 in. in diameter is being offered. Recommended heating system is sectioned aluminum sheathing with resistance heaters cast in. Sheathing is ribbed for uniform cooling by air blowers that are mounted outside the extruder covering for longer life and cooler intake. (Other types of heating and cooling can be had if desired.) In the 2- and 2.5-in. sizes, a choice of speed ranges is offered with top speed either 150 or 200 r.p.m. Motor horsepowers range from 10 to 15 on the 2-in. standard machine to 150 to 200 on the 8-in. vented. In the under-2-in. class, 1.5-in. standard and vented machines are offered, and there are two 1-in. models, one mounted on an adjustable pedestal to facilitate its use in two-color extrusion. Three standard screw designs are available for all the non-vented models. Instrumentation includes usual pyrometers for multi-zone heat, head-pressure gage, and per-cent-load indicator. *Modern Plastics Machinery Corp., Lodi, N. J.*

MPM pedestal mounted extruder, one of a new line, is especially adapted to two-color extrusion

Compact beta-ray gage

Designed especially for measurement of thicknesses of thin plastic films, a "miniaturized" source-detector unit requires only 12 in. of machine-direction space, is available for various film widths and for either horizontally or vertically traveling film. Source radiation passes through sheet and fraction absorbed is noted by detector on other side. Since absorption depends on thickness, a continuous monitor, sensitive to millionths of an inch, is kept on film thickness. Signal from detector feeds into maker's type E equipment, which can be set up to indicate, record, and control the thickness. *Industrial Nucleonics Corp., 1205 Chesapeake Ave., Columbus 12, Ohio.*

Large injection machine

The Type AP335 injection machine has a nominal shot capacity, in polystyrene, of 210 ounces. The melt supply for the injection ram is generated by an ingenious twinscrew plasticating unit with intermittent rotational and stuffing action. The nozzle valve, open during injection, is shut off dur-

*Specifications, claims made, and prices appearing in these pages are those of the manufacturers or sellers of the machinery and equipment described, or their agents. Prices are deemed to be F.O.B. sellers' plants (unless otherwise stated), are for "standard" models and are subject to change without notice. The publishers and editors of MODERN PLASTICS do not warrant and do not assume any responsibility whatsoever for the correctness of the same, or otherwise.

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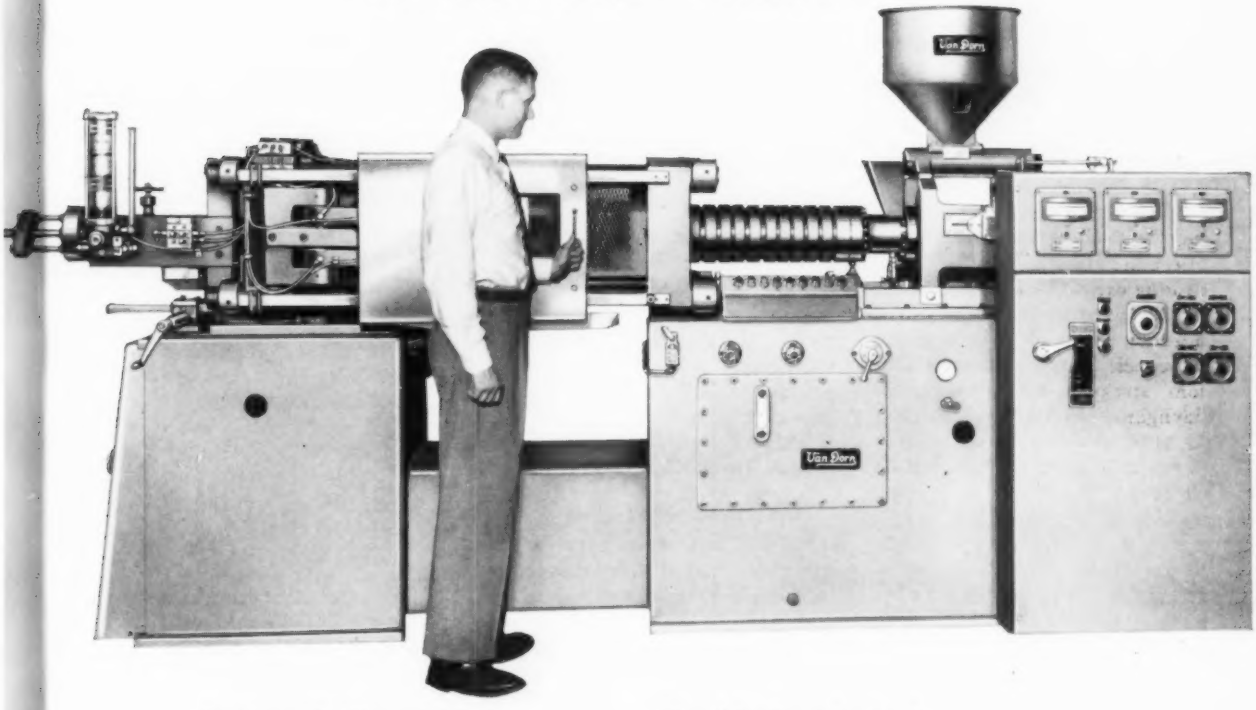

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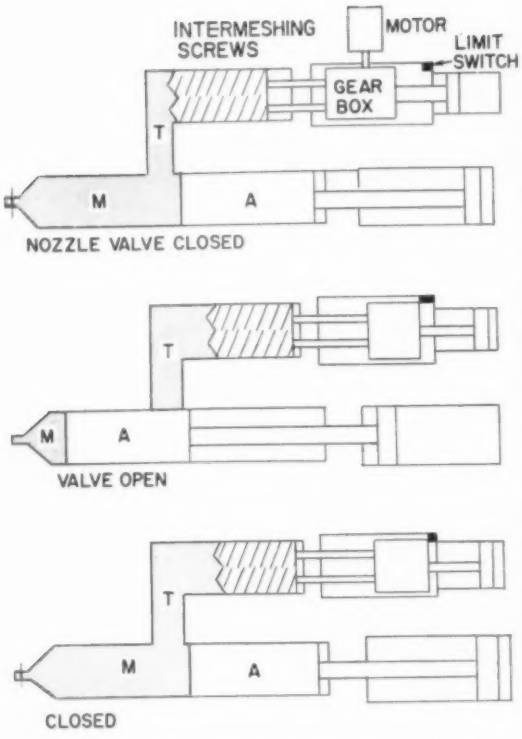


Windsor 210-oz. molder with twin-screw preplasticator cycles thus: Top—mold halves (not shown) close, while injection ram A is retracted; screws have shifted forward, transferring melt into injection chamber M. Center—ram comes forward, mold fills; as piece chills, screws start turning and force themselves back while filling transfer chamber T. Bottom—Plunger A retracts, screws strike preset limit switch (setting determined by shot weight), and stop turning; piston forces them forward, transferring charge from T to M. Mold opens and piece is removed, ending cycle

ing the cooling period when the injection cylinder is stuffed. Plasticating capacity is 420 lb./hr., injection pressure is 12,500 p.s.i., injection stroke of 17 in. requires 3 seconds. Clamping force is 1150 tons, stroke is 42 in., maximum daylight is 86 inches. Molds up to 40 in. wide by 70 in. high or 62 in. wide by 48 in. high can be clamped. Mold thickness may range from 12 to 44 inches. Heater power is 30 kw., horsepower to three pumps totals 150, while screw drive is powered by 25-hp. motor. *R. H. Windsor, Ltd., Leatherhead Rd., Chessington, Surrey, England.*

Resin degasser

Deaeration of casting and molding resins is made fast and economical by a simple degassing apparatus. Operating with 50-gal. batches, the degasser can process from 500 to 1500 lb./hr. of material (models in other sizes made on order), can deaerate 30,000-cp. plastisol in one pass. It consists of a vacuum tank with a valved feed line and a distributor that spreads the incoming liquid into a thin film. The tank is pumped down in 8 to 10 min., and the resin is allowed to flow in. Degassed resin collects at bottom, discharges by gravity after vacuum cycle is ended. Vacuum pump has 15-c.f.m. rating, is driven by 1-hp. explosion-proof motor, is protected by entrainment trap. Carbon steel is standard material of construction, but any alloy can be had. *Specialty Equipment Div., Chemineer, Inc., 1044 E. 1st St., Dayton 2, Ohio.*

Multipurpose press

A 35-ton hydraulic press with a working area of 48 by 40 in. can be used for trimming moldings and formings as well as for blanking, punching, and forming. Stroke is 30 in., approach speed is 1400 in./min., pressing speed is 140 in./min., return speed is 700 in./min. The press (like other models in the line) is air-hydraulically actuated. Since the air cycles between the press and the accumulator, the only air supply needed is to replace leakage. *B & T Machinery Co., Holland, Mich.*

Vacuum metallizer

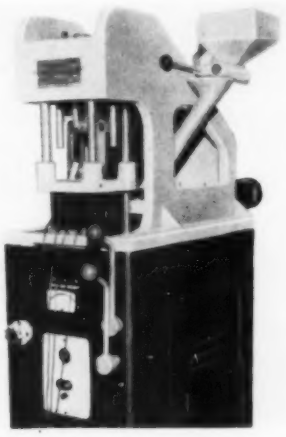
New coater is equipped with 16-in. high-vacuum valves, making it possible to pump down to operating pressure in about 1.5 minutes. The valves are so located that they are never exposed to the atmosphere, so they add no outgassing or pumping time to the cycle. This design also permits cleaning the inside of the unit with caustic spray through a handhole, fumes being vented outdoors. Vacuum cycle is semi-automatically controlled, making it almost impossible to misoperate the unit and spoil work loads. *Vacuum Specialties Co., Inc., Somerville, Mass.*

Ball-check nozzle

A two-piece ball-check nozzle, designed for use with nylon or polystyrene and with hot-runner molds or center-gated parts where a positive shut-off is wanted, fits all machines using the 1.75 by 8-in. thread. The nozzle can be adapted to almost any machine provided sufficient nozzle space is available. Ball and spring are stainless steel, easily replaced. Two 75-w. heater bands keep melt fluid, insure positive shut-off. Prices vary with make and model of machine; standard Reed model costs $175.50. *Injection Molders Supply Co., 3514 Lee Rd., Cleveland 20, Ohio.*

Miniature injection machine

The Eldorado model 70VC95 injection molder has a shooting capacity of from ⅓ to 1½ oz., can develop top injection pressure of 30,000 p.s.i. Vertical construction and clamping make it easy to work with inserts and cores. Bottom half of mold remains sta-



Eldorado Model 70VC95 ⅓/1.5 oz. vertical injection machine has self-contained hydraulic system

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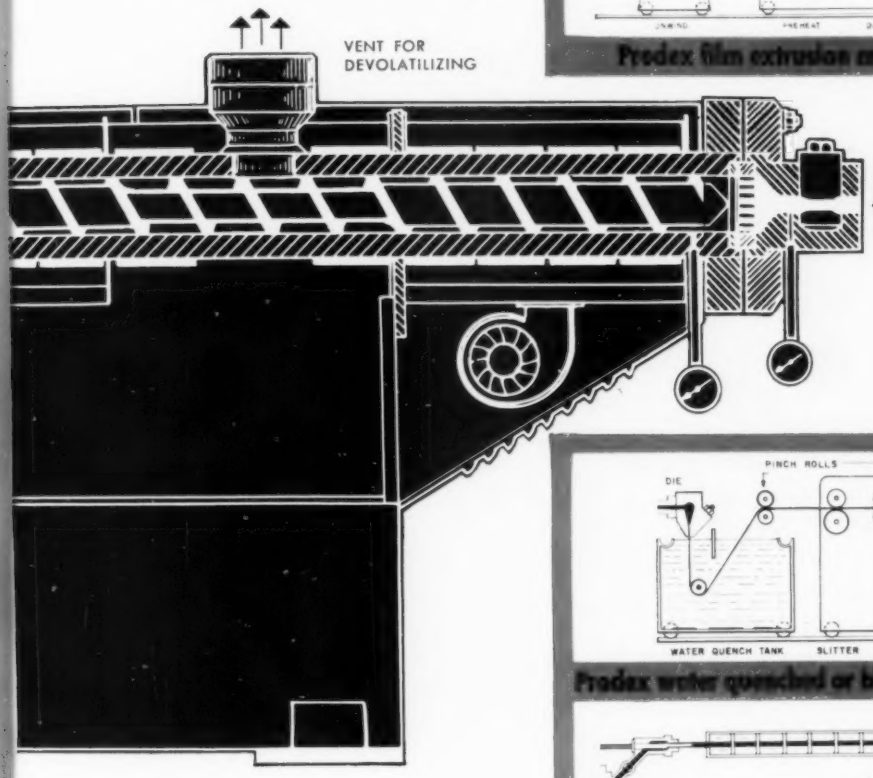
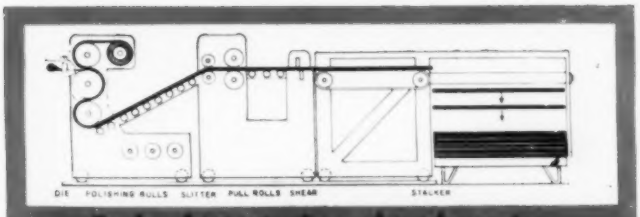
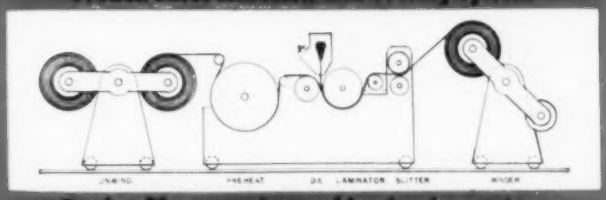


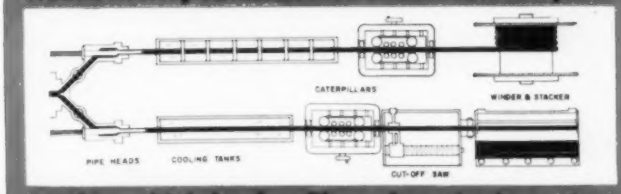


Prodex sheet extrusion and overlay system

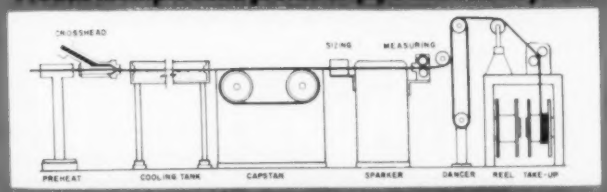


Prodex film extrusion and laminating system

Prodex water quenched or blown film extrusion system



Prodex multiple head profile or pipe extrusion system



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tionary. Clamping and injection pressures are powered by self-contained Vickers hydraulic system. All thermoplastics can be molded. *Newbury Industries, Inc., Route 87, Newbury, Ohio.*

Injection molder

For some years it has been said that screw extrusion is a more efficient way to melt down molding powder than cooking it in an injection cylinder. Some European injection machines have successfully used screw plasticators, but the idea has been slow in taking hold in this country. Now the first American machine incorporating this principle has been announced by Reed-Prentice.

Specifications for Reed-Prentice Jetflo 6-oz. machine

Material injected per shot, oz., 6
Plasticating capacity, lb./hr., 100
Injection pressure, p.s.i., 16,000
Injection plunger stroke, in., 6
Injection plunger speed, in./sec., 6
Injection plunger speed with accumulator, in./sec., 20
Mold clamping pressure, tons, 175
Mold clamping stroke (adjustable), in., 5 to 8
Mold thickness, in., 6 to 14
Mold size, max. (horiz. by vert.), in., 22 by 13.5
Platen size (horiz. by vert.), in., 22 by 24.2
Space between tie bars (horiz. by vert.), in., 13.5 by 13.5
Approximate projected casting area, sq. in., 75
Dry cycle time, sec., 1.3 to 2.9
Pump motor, h.p., 40

Called the Jetflo, the new machine is being offered first in a 6-oz. size with a plasticating capacity of 100 lb./hr., a rate more typical of machines of twice this shot capacity. The machine consists essentially of a clamping mechanism, an extruder with a hollow screw, and an injection ram that is coaxial with the screw. The tip of the screw is tapered and perforated with small holes that permit the melted plastic to pass into the reservoir inside the screw and in front of the withdrawn ram. The screw is relatively short (for these days) and the barrel is jacketed for cooling in all but the forward section, where, it is claimed, most of the plasticating action occurs. The heaters over the jackets can deliver up to 15.4 kilowatts. The screw turns continuously at an adjustable speed, powered by its own 5-hp. Varidrive. Injection speed is 10.6 cu. in./sec., standard, or over three times that figure with a small optional accumulator. The single screw design appears to serve well for all thermoplastics. Operating specifications are listed in the accompanying table.

The machine cycles very rapidly, has produced thin-wall cups on a 1.7-sec. cycle. A cosmetic box of medium-impact polystyrene used to be run in a Reed 12/16-oz. machine on a 22-sec. cycle. In the Jetflo this 3-oz. shot ran in 17 seconds. Because there is only melt in front of the ram, injection pressures and temperatures can be lower, as with some other preplasticating machines. A shut-off valve at the forward end of the melt reservoir permits precompression of the melt. Thermal exposure of the material is very low, and screw plastication gives very uniform melt temperatures as well as excellent dry coloring results.

The very small inventory of melt means easy purging. However, it is simple to pull the screw if one should want to. *Reed-Prentice Div., Package Machinery Corp., East Longmeadow, Mass.*

Rotary cutter for flat stock

A line of rotary cross-cutters can cut lengths from rolls of film or sheet stock and can also be synchronized with production line. The machine will cut lengths from 2 to 60 in. from stock of widths from 24 to 60 in., at speeds up to 50 cuts/minute. It can be supplied with or without a longitudinal slitting device, unwinding stands, run-out conveyors, and stackers. Price without accessories ranges from $5000 to $8000, depending on width of unit. *Hobbs Mfg. Co., 26 Salisbury St., Worcester, Mass.*

Rotational casting oven

An important step forward in the design of double-rotation ovens for plastisol molding is the introduction by E. B. Blue Co. of open racks to hold the molds. These racks replace the old-style solid plates and permit the hot

The NEW PRODEX HENSCHEL MIXER

THE NEW PRODEX-HENSCHEL MIXER

is used successfully in many installations here and abroad to prepare compounds ready for extrusion and molding, such as: **unplasticized rigid PVC dryblend, plasticized PVC dryblend, polyethylene colorant powder mix, cellulose acetate dryblend, PVC record compound, etc.**

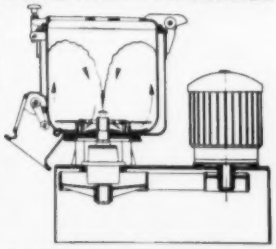
The PRODEX-HENSCHEL MIXER performs intensive dryblending and thorough dispersion of colors, pigments, fillers, stabilizers and/or plasticizers with plastics powders or granules.

It permits, if desired, the mechanical (frictional) heat-up of plastics powders faster and more uniformly than by conduction or radiation.

The unique principle of fluidizing dry powders so that they can be mixed like liquids, plus controlled shearing action, result in mixing quality and mixing speeds heretofore not obtained.

Design and Operation of the PRODEX-HENSCHEL MIXER

A cage-like ring of pins rotates concentrically around a stationary ring of pins. The rotating member also carries specially shaped blades and impellers which aerate and propel the powders to be mixed. The action is similar to that of a high-speed stirrer. The aerated powders or granules flow downward through the center of the rotating ring and pass through the zone of shearing between the rotating and stationary pins. The blend then moves upward along the wall of the mixing chamber. The entire batch rotates slowly around the axis of the mixing chamber. The rotating member of the mixing mechanism is usually operated at peripheral speeds of 100 to 200 ft/sec. The spacing between the rotating and stationary pins determines the shearing action. The shearing action controls mixing and dispersion as well as mechanical heat-up.



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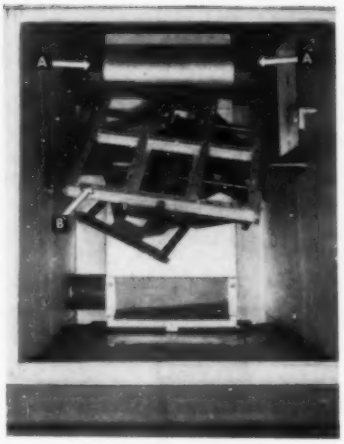


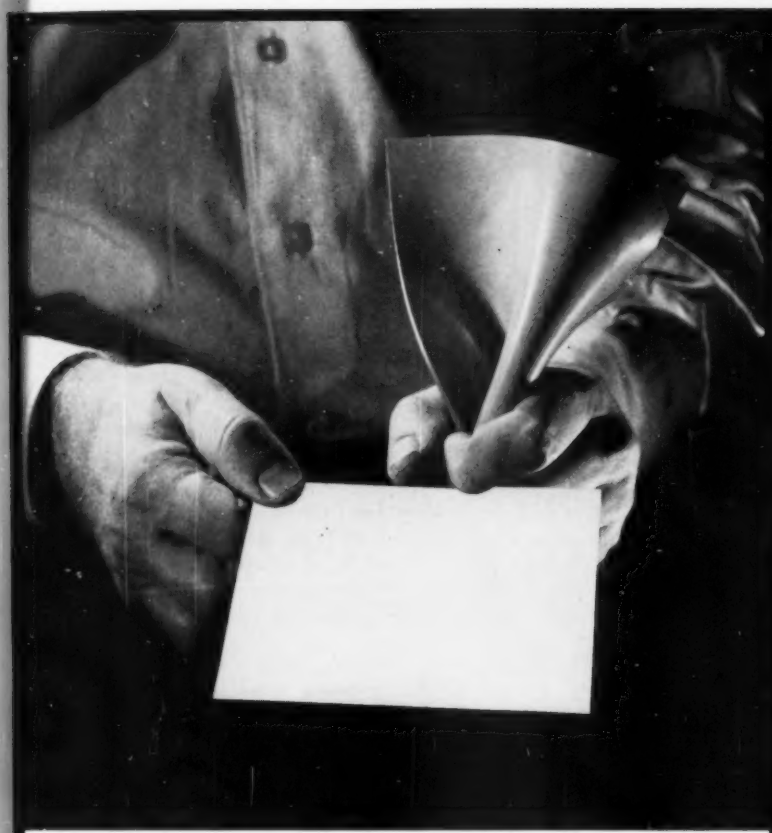
Blue oven interior showing dual blowers "A" at top corners; air blows downward onto new open-frame mounting rack "B" for molds

air to reach the bottoms and lower sides of the molds as well as the upper portions. This results in significant shortening of molding cycles and gives more uniform cures. Heat transfer in these ovens has been improved also by the addition of a second fan at the top of the oven to increase turbulence. An inside view through the end door is shown above. *E. B. Blue Co., Connecticut Ave., S. Norwalk, Conn.*

Wire take-up

Wire speeds up to 4000 ft./min. are possible on the dual-reel Model DR-24HS wire take-up, which is specifically designed for continuous reeling of lighter-gage wires at high speeds. Handling reels from 12 to 24 in. in diameter, the new take-up automatically cuts over from a full reel to an empty one without reduction in speed. Loading and unloading operations are pneumatically powered to eliminate lifting by operator. Friction-disk drive makes for fast reel replacement. Wire tension is adjustable from 2 to 10 lb. and traverse is adjustable for wire lay and width.

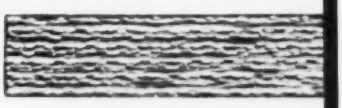
The take-up is powered by two 5-hp. motors with eddy-current clutches and automatic braking. Rotating parts are mounted on ball bearings. Also available is automatic meter for signaling and/or totalizing wire footage. *Davis-Standard, Mystic, Conn.*—END



BOTH ARE MADE FROM PLASTISOLS. You control the rigidity. The sheet in the foreground has more PMDA and epoxidized plasticizer, for greater rigidity. By varying the ratios of ingredients, you can get hardness from 17 to 80 (Shore D), tensile strength up to 5000/psi and a broad range of elongations. (Figures are based on recent laboratory tests.)

MORE HEAT RESISTANT. PMDA plastisol (left) and commercial rigid vinyl (right) were heated for one and a half hours in an oil bath to 430°F. The rigid plastisol withstood heat while unplasticized vinyl was badly distorted.

COATINGS AND CASTINGS are easily made with liquid-state plastisol system. L. to r.: flow-coated pipe, cast ash tray, cosmetic bottle with strong, colorful vinyl coatings, and dipped tool handle.



LAMINATES REINFORCED WITH GLASS FABRIC can be made because of the good adhesion of PMDA plastisol. Shown here: Rigid plastisol reinforced with 10 layers of glass fabric. Such laminates have load bearing properties at as high as 300°F., compared to 150°F. limit usually placed on commercial rigid PVC.

Look what can now be done with PLASTISOLS!

You can make rigid vinyl castings and moldings with convenient plastisol techniques . . . and a helping hand from Du Pont's PMDA

You're looking at a wide range of products made from plastisols.

Using ordinary plastisol techniques—you can mold, cast, spray, dip, or roller coat to produce such PVC products as coated tool handles, mechanical parts, floor tiles, vinyl-lined pipe, bottle coatings . . . even glass laminates . . . and many more mass production items.

And you get the properties of a tough, rigid vinyl!

Du Pont's PMDA (pyromellitic dianhydride) is the curing agent that makes all this possible. Along with an epoxidized plasticizer with which it reacts to strengthen and harden the resin, PMDA gives the plastisol precisely the rigidity you desire.

To vary the hardness, you vary the quantity of PMDA and epoxidized plasticizer.

This technique offers distinct advantages over other rigid-plastisol systems in that it offers a high maximum hardness, adhesion without a primer, and it does not produce exothermic reaction difficulties.

If you're working on a rigid-vinyl product, it may pay you to look further into this new rigid plastisol technique. To help you in your development work, we can supply PMDA from our new semi-commercial facilities.

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Books & Booklets

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"Structural Adhesives—an introduction for potential users"

Written and published in 1958 by Structural Adhesives Associates, 907 N. 17th St., Allentown, Pa. 62 pages. Price: $9.50.

This little primer on adhesives, an outcome of a study by a group of students at the Graduate School of Business Administration of Harvard University, should be very useful to its intended audience and may give some old users of adhesives some new information. It begins by pointing out the complexity of the subject, then divides into three sections. The first summarizes the existing theory and practical limitations. Section 2 discusses the uses of adhesives and their performance in the aircraft, auto, metalworking, and construction industries. Section 3 deals with marketing, lists producers of adhesives and handling equipment. It includes a good checklist of information that the potential user should furnish the adhesive producer to help him in prescribing the proper adhesive for the job. On the whole, the report is soundly based, inclusive, and concise.—*J.F.C.*

"Epoxydverbindungen und Epoxydharze" (Epoxy compounds and epoxy resins)

By A. M. Paquin

Published in 1958 by Springer-Verlag, Reichpietschufer 20, Berlin W 35, Germany. 833 pages. Price: DM 88 (about $21, U. S.)

To someone deeply involved in epoxy chemistry and manufacture, it is worth learning enough German to read this encyclopedic work. Its scope and completeness cannot be conveyed in a short review, and we give only the major subdivisions: 1) Ethylene oxide and its halogen-free homologs; 2) Halogen-containing alkene oxides; 3) Epoxy compounds (this has a list of 387 known compounds with structural formulas and melting or boiling points, where known); 4) Polyphenols; 5) Epoxy resins; 6) Curing and curing methods; 7) Uses of epoxy-resin derivatives and products; 8) Testing and test methods; 9) Chemical analysis and identification; 10) The place of epoxy resins in the plastics industry throughout the world; 11) Manufacturers and tradenames. Thousands of patent and literature references, up to the end of 1957.—*J.F.C.*

"New Jersey Industrial Directory (plus 'The New Jersey Industrial Market Place'). 1958-1959 Edition"

Published in 1958 by New Jersey State Industrial Directory, Port Authority Bldg., 111 Eighth Ave., New York 11, N. Y. 500 Pages. Price: $25.00.

Lists over 14,000 manufacturing and non-manufacturing industrial firms, giving names and titles of officers, number of employees, telephone number, address, etc. Firms are listed alphabetically, by geographical location, and by product or service.

Laminating resin. Physical properties, applications, step-by-step method of laminating, etc., for Epolite 90 epoxy resin used in surface coating and laminating. Bulletin RPD 900. 4 pages. *Rezolin, Inc., 1651 18th St., Santa Monica, Calif.*

Polyethylene. "Petrothene Polyethylene . . . a Processing Guide" covers every significant aspect of polyethylene processing techniques, from basic chemistry of the resins to fabrication of end-products, including properties; uniformity, compounding, and blending; packaging and shipping; and other technical data. Bibliography. 100 pages. *U. S. Industrial Chemicals Co., 99 Park Ave., New York 16, N. Y.*

Plastics-synthetic rubber blends. "Blends of Hypalon with Other Elastomers and Plastics" includes technical data on the use of Hypalon, a synthetic rubber, as a modifier for PVC and polyethylene. Report BL-339. 12 pages. *E. I. du Pont de Nemours & Co., Inc., Elastomer Chemicals Dept., Wilmington 98, Del.*

Plastics tanks. Specifications, design features, applications, etc., for a line of standard tanks in branch and linear polyethylene and polypropylene. 2 pages. *American Agile Corp., P. O. Box 168, Bedford, Ohio.*

Polyvinyl chloride compounds. "Injection Moulding of Geon Unplasticized PVC Compounds" gives type of equipment needed, and technical data on pressure; design of cylinder; spreader and mold; heating and temperature control; starting-up; shut-downs; precautions to avoid decomposition; etc. Geon Tech. Note #G202. 8 pages. *British Geon, Ltd., Devonshire House, Piccadilly, London, W1, England.*

Production facilities. Description of facilities, products, etc., of custom plastics molder. 4 pages. *Makray Mfg. Co., 4400 N. Harlem Ave., Chicago 31, Ill.*

Forming polyethylene. Mold design, heating and cooling, cycles, etc., for thermoforming of Rigidex high-density polyethylene sheet into housewares, sterilizable hospital ware, etc. 4 pages. Information Sheet #3. Physical properties, processing data, applications, etc., for the extrusion of Rigidex high density polyethylene. 4 pages. Information Sheet #4. *British Resin Products, Ltd., Devonshire House, Piccadilly, London W1, England.*

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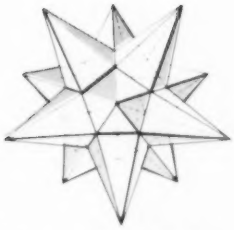

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test methods, etc., for 26 RC plasticizers and seven comonomers, which are both ester-types. The comonomers are said to copolymerize with many other monomers, such as vinyl acetate, vinyl chloride, styrene, etc. 50 pages. *Rubber Corp. of America, Hicksville, N. Y.*

Pale, non-yellowing terpene resins. Physical and chemical properties, compatibility, solubility, viscosity, applications, etc., for Piccolyte pale, non-yellowing terpene resins. Applications include polyethylene extruders, plasticizers, etc. 8 pages. *Pennsylvania Industrial Chemical Corp., Clairton, Pa.*

Plastic laminates. Facilities, materials list, technical data, price lists, etc., regarding plastic laminates for the electrical and electronic industries. 24 pages. *New England Laminates Co., Inc., 481 Canal St., Stamford, Conn.*

Fabricating facilities. Text and photos describe facilities available for fabricating laminated plastics and vulcanizing fibre parts. 12 pages. *Taylor Fibre Co., Norristown, Pa.*

Contact cements. Reference folder contains technical bulletins covering properties, recommended bonding techniques, handling, etc., for 11 grades of Instant-Lok contact cements. 18 pages. *Structural Products Div., National Starch Products, Inc., 750 Third Ave., New York, N. Y.*

TAS liquid heat transfer systems. Design and installation, applications, and other technical data on high temperature liquid heating and cooling systems for use in the production of resins and plastics, utilizing tetra aryl silicate (TAS) as the heat transfer medium. 12 pages. *American Hydrotherm Corp., 10-55 Jackson Ave., Long Island City 1, N. Y.*

Glycols. Analytical procedures, properties, vapor pressure, sales specifications, viscosity, dew point, surface tension, boiling point, hygroscopicity, freezing point, heat capacity, chemical properties, uses, etc., for ethylene,

diethylene, triethylene, and tetraethylene glycols, including applications in the dehydration of resins, plastics, plasticizers, etc. 234-item bibliography. 42 pages. *Jefferson Chemical Co., Inc., 1121 Walker Ave., Houston 2, Tex.*

Coding, marking, and imprinting machines. Illustrated brochure on a line of automatic coding, marking, and imprinting machines for plastics film, packages, and products. 4 pages. *Adolph Gottscho, Inc., Hillside, N. J.*

Polyvinyl Acetate Emulsions. Technical data on the manufacture, modification, and processing of polyvinyl acetate emulsions, along with the properties of the emulsions and their films. Includes test methods data. Monograph #1. 38 pages. *Vinyl Products, Ltd., Butter Hill, Carshalton, Surrey, England.*

Meter, Mix, and Dispense. Design, operation, and means of automating the Triplematic pump for mixing, metering, and dispensing two-part resins. 4 pages. *H. V. Hardman Co., Inc., 571 Cortlandt St., Belleville 9, N. J.*

Production facilities. Tooling, designing, and production services available to handle custom-molded nylon requirements. 4 pages. *Nylomatic Corp., Morrisville, Pa.*

Tapes and sheets. Properties, tolerances, bonding techniques, applications, etc. for glass-supported, and metal-clad Teflon sheets and tapes. Bulletin CT-58. 4 pages. *Continental-Diamond Fibre Corp., Newark, Del.*

Copper-clad laminates. Properties chart for 11 grades of copper-clad materials for printed circuit applications. "A Better Foundation for Printed Circuitry." 6 pages. *National Vulcanized Fibre Co., 1058 Beach St., Wilmington 99, Del.*

Plastics granulator. Specifications, advantages, etc. for a rotary knife granulator. 4 pages. *American Pulverizer Co., 1249 Macklind Ave., St. Louis 10, Mo.*—END

Reinforced plastics conference

Program of 14th annual session, to be held Feb. 3-5, 1959, at the Edgewater Beach Hotel, Chicago, Ill.

Registration for the 14th Annual Conference of the Reinforced Plastics Div. of The Society of the Plastics Industry, Inc., will begin at 12:00 noon on Monday, Feb. 2. The program follows:

Tuesday, February 3

9:30 A.M. to 12:00 noon—Concurrent sessions on Preform and Mat Die Molding, High Temperature Applications, and Joining of Reinforced Plastics.

Session I—Preform and Mat Die Molding

Presiding: Arthur J. Wiltshire, Apex Reinforced Plastics, Div. of White Sewing Machine Corp.
Vice Chairman: Harry Cote, Plastics and Coal Chemicals Div., Allied Chemical Corp.

"Mass Production of Fiber Glass Reinforced Consumer Products," R. E. Mollman, Plastic Products Corp.

"Open Spray Preforming," E. Garretson, Molded Fiber Glass Co.

"Planned Profits with Managerial Controls," Spencer Tucker, Martin & Tucker, Engineers.

"Varying Time and Temperature on the Physical Properties of Cured Laminates," Charles B. Sias, Pittsburgh Plate Glass Co.

"Preforming with Continuous, Uncut Fiber Glass Roving," J. G. Mohr, Plastics and Coal Chemicals Div., Allied Chemical Corp.

Session II—High Temperature Applications

Presiding: G. A. Stein, A. O. Smith Corp.
Vice Chairman: T. B. Blevins, Office of the Chief of Ordnance.

"The Behavior of Reinforced Plastics at Very High Temperatures—Part II," I. J. Gruntfest and L. H. Shenker, G-E, Aeroscience Lab.

"High Temperature Asbestos Reinforced Plastic Missile Parts," D. V. Rosato, Raybestos-Manhattan, Inc.

"The Effect of One Side High Temperature on Mechanical Behavior of Reinforced Plastics," H. T. Plant and L. S. Lazar, G-E.

"Mechanical Testing at Extremely High Temperature," Grant Brown, Cordo Chemical Corp., and Dr. K. Coons, Head, Chemical Engineering, University of Alabama.

"Plastic High Temperature Rectangular Pressurized Electronic Container," Clifford K. Lodder, G-E, Defense Electronics Division.

Session III—Joining of Reinforced Plastics

Presiding: H. A. Perry, Jr., U. S. Naval Ordnance Laboratory.
Vice Chairman: Ray Armstrong, Owens-Corning Fiberglas Corp.

"Adhesive Bonding of Reinforced Plastics," R. H. Wagner, Owens-Corning Fiberglas Corp.

"Types of Bonds Involved in Adhesion," Prof. John E. Rutzler, Case Institute of Technology.

"Mechanical Fasteners for Reinforced Plastics," M. D. Weiss, Owens-Corning Fiberglas Corp.

"The Effects of Stress Concentrations on the Strength of Reinforced Plastics Laminates," Eric L. Strauss, The Martin Co.

12:30 to 2:00 P.M.—Luncheon.

Welcoming Address: James N. Grove, J. P. Stevens & Co., Inc.

2:00 to 5:00 P.M.—Concurrent sessions on Preform and Mat Die Molding, Mechanical Behavior of Reinforced Plastics, and Reinforced Plastics Tooling.

Session I—Preform and Mat Die Molding

Presiding: A. W. Levenhagen, Molded Fiber Glass Tray Co.
Vice Chairman: G. William Burton, Westinghouse Electric Corp., Micarta Div.

"Mold Designs," Thomas Harris, Structural Fibers, Inc., and Arthur J. Wiltshire, Apex Reinforced Plastics, Div. of White Sewing Machine Corp.

"Special Problems in Molding Large Parts," Morgan Martin, Molded Fiber Glass Co.

"Hydraulic Controls and Systems," William Lytle, Lytle Engineering Co.

"What Are You Paying For? Volume Costs in Matched Metal Molding," Arthur Smith, Rohm & Haas Co.

Session II—Mechanical Behavior of Reinforced Plastics

Presiding: L. S. Lazar, G-E, General Engineering Lab.
Vice Chairman: Harry R. Nara, Professor of Engineering Mechanics Structures, Case Institute.

"Use of Elevated Temperature Creep and Relaxation Effects as a Means of Non-Destructive Quality Control Testing for Finished Reinforced Plastic Articles," A. D. Coggeshall, G-E, Materials and Processes Laboratory.

"Dissipation of Energy at Large Strains and Rates of Strain," Harold Loveless, American Cyanamid Co., Research Div.

"Long-term Loading of Glass Reinforced Plastic Laminates," K. H. Boller, U. S. Dept. of Agriculture, Forest Products Laboratory.

"Maximum Allowable Stresses for Glass Cloth Laminates Under Water," John Delmonte, Furane Plastics, Inc.

Session III—Reinforced Plastics Tooling

Presiding: Fred Lyijynen, Chrysler Corp., Automotive Body Div.
Vice Chairman: Alan Fullarton, Convair Astronautics.

"Stretch Tool Die Design with Reinforced Plastics," B. J. Bryan,

and Lew Winter, Furane Plastics, Inc.

"Production Plastic Dies Up to 50,000 Pieces and the New Pressure Casting Method of Die Making," W. R. Weaver, Modern Pattern & Plastics, Inc.

"Master Models, Keller Models, etc., Their Cost, Fabrication and Use in Industry; and Plastic Tooling as Used in Prototype Programs," H. Wyatt, Ford Motor Co., Metal Stamping Div., and J. G. O'Reilly, Ford Motor Co., Manufacturing Staff.

"Recent Progress in Plastic Tooling and the Future of Plastic Tooling," I. Poston, General Motors Technical Center.

Paper to be read from Western Section, S.P.I. Plastics and Tooling Div.

Wednesday, February 4

9:00 A.M. to 12:00 noon—Concurrent sessions on Aircraft and Missiles; Premix—Molds, Materials and Methods; and Transportation—Commercial and Military.

Session I—Aircraft and Missiles

Presiding: Samuel S. Oleesky, Zenith Plastics Co., Subsidiary, Minnesota Mining & Mfg. Co.
Vice Chairman: Clare E. Bacon, Owens-Corning Fiberglas Corp.

"Structural Plastic Target Drones and Missiles," Carl S. Seybold, Jr., Radioplane Co., Div. of Northrop Aircraft, Inc.

"Reinforced Plastics Applied to Helicopter Rotor Blades," D. F. Thompson, Prewitt Aircraft Co.

"Protective Coatings for Electronic Laminates," J. R. Lampman, G-E, Defense Electronics Div.

"Epoxy-Fiberglass Molded Channels for DC-8 Flooring," John G. Stansbury, Swedlow Plastics Co.

Session II—Premix—Molds, Materials, and Methods

Presiding: Robert J. Brinkema, Firmaline Products, Inc.
Vice Chairman: Lawrence Wittman, Lawrence Wittman & Co.

"Physical Measurments in Premix," Seymour Feuer, Atlas Powder Co.

"Survey of Mold Design for Premix." Speaker from Wallace & Tiernan, Inc. to be announced.

"Problems with Premix Molding," Will E. Sole, Glastic Corp.

"Presentation and Analysis of Successful Products; Design, Materials, Molding and Costs," William Scott, Atlas Powder Co.

"Premix Forum." Authors and leading premix molders to answer questions and discuss premix molding, its advantages and disadvantages.

"To Compound or Not To Compound; That Is the Question."

Session III—Transportation—Commercial and Military

Presiding: John F. Reeves, Consulting Engineer.
Vice Chairman: Donald G. Estey, American Cyanamid Co.

"Balancing Reinforced Plastics' Advantages with Practical Economics for Successful Railroad Operation," J. C. Cassidy and Robert Kennedy, ACF Industries.

"Reinforced Plastics in Merchant Shipping Containerization—A Big Potential." Speaker to be announced.

"Why the Trucking Industry Looks to Reinforced Plastics for Improved Performance," Kenneth C. Sanders and George B. Luhman, The Heil Co.

12:30 to 2:00 P.M.—Luncheon.
Presiding: William T. Cruse, Exec. Vice Pres., S.P.I.
Address: *"The Reinforced Plastics Industry in Russia,"* James E. FitzGerald, The Brunswick-Balke-Collender Co.

6:00 to 7:00 P.M.—Reception.

7:00 P.M.—Annual Banquet.
Toastmaster: A. W. Levenhagen, Molded Fiber Glass Tray Co., and General Chairman, S.P.I. Reinforced Plastics Div.

Executive Committee Awards.

Thursday, February 5

9:00 A.M. to 12:00 noon—Concurrent sessions on Research; Raw Materials; and Reinforced Plastics Processing.

Session I—Research

Presiding: W. Burdette Wilkins, Consulting Engineer.
Vice Chairman: Prof. Frederick J. McGarry, M.I.T.

"Solarization Studies on Polyester Resins," R. C. Hirt and R. G. Schmitt, American Cyanamid Co., Research Div.

"Shrinkage Pressures During Resin Cure," R. E. Chambers, M.I.T., Plastics Research Lab.

"Tensile Impact Measurements on Reinforced Plastics," R. H. Calderwood and A. J. Bush, Westinghouse Electric Corp.

"Effects of Nuclear Radiation on Structural Plastics," R. C. Tomashot, Wright Air Development Center, Plastics Products Section.

"Resin-Glass Bond Strength Studies," R. D. Mooney and F. J. McGarry, M.I.T.

Session II—Raw Materials

Presiding: Maurice Martin, Martin & Tucker.
Vice Chairman: L. Stievator, Jr., McKesson & Robbins, Inc.

"Hollow Glass Microspheres," William R. Cuming, Emerson & Cuming, Inc.

"Metallurgical Improbabilities Through Plastics," John Delmonte, Furane Plastics, Inc.

"Synthetic Fiber Fabrics and Batts as Reinforcements for Polyester Resin Laminates," W. L. Park, Puget Sound Naval Shipyard, Bremerton, Wash.

"Epoxy-Glass Reinforcement," T. E. Phillips, Owens-Corning Fiberglas Corp.

"Stanpreg G-Pl; A New Polyester Preimpregnated Glass Cloth," H. J. Ried, Standard Insulation Co.

Session III—Reinforced Plastics Processing

Presiding: George Lubin, Grumman Aircraft Engineering Corp.
Vice Chairman: P. Robert Young, Wallace & Tiernan, Inc.

"Reinforced Low Density Molding," Robert F. Newberg and Donald L. Graham, The Dow Chemical Co.

"Surface Heated Molds," Grant Brown, Cordo Chemical Corp.

"Fibre Glass Reinforced Plastics in the Chemical Industry in England," Francis F. Jaray, Consulting Engineer, England.

"Comparative Economics and Performance of FRP Fabricating Processes," G. S. McElroy, Owens-Corning Fiberglas Corp.

"Reinforced Polyester Resins in Plant Maintenance: Specific Case Histories of Applications in Var-

ious Celanese Plants," J. P. Barker and T. J. Welsh, Celanese Corp. of America, Plastics Div.

12:30 A.M. to 2:00 P.M.—Luncheon.

2:30 to 5:30 P.M.—Concurrent sessions on Research; Raw Materials; and Boats—Commercial and Naval.

Session I—Research

Presiding: Donald M. Joseph, Ciba Co., Inc.
Vice Chairman: Prof. Frederick J. McGarry, M.I.T.

"Mechanism of Adhesion," R. R. Stromberg, A. R. Quasius and W. M. Lee, U. S. Department of Commerce, National Bureau of Standards.

"Differential Thermal Analysis of Resins," Dr. C. B. Murphy, G-E, General Engineering Lab.

"Shear Effects in FRP Flexural Behavior," R. E. Chambers and F. J. McGarry, M.I.T.

"Arcing and Tracking Resistance of Reinforced Plastics," H. L. Sheppard, Westinghouse Electric Corp., Materials Engineering Dept.

"Failure Mechanisms in FRP," M. B. Desai, M.I.T.

Session II—Raw Materials

Presiding: T. J. Jordan, G-E.
Vice Chairman: Hartley K. Phinney, Union Carbide Plastics Co., Div. of Union Carbide Corp.

"Properties of Isophthalic Acid Unsaturated Polyesters at Elevated Temperatures and Fatigue Properties of Isophthalic Acid Unsaturated Polyesters," G. B. Johnson, California Research.

"1,4-Butanediol Diglycidyl Ether (BDGE)—A Reactive Diluent for Epoxy Resins," Frank E. Pschorr and Elliott N. Dorman, Ciba Co., Inc., Plastics Div.

"C-Oil, A New Hydrocarbon Thermosetting Resin for Reinforced Plastics," H. Clark and B. M. Vanderbilt, Esso Research and Engineering Co.

"Rigid Urethane Foams for Improved Glass Reinforced Sandwich Radomes," Howard R. Moore, U. S. Naval Air Development Center, Johnsville, Pa.

"Glass-Reinforced Acrylic Plastics—Factors Involved in the Selection of Cure Systems," John W. Van Dyk and C. Eugene Bennett, E. I. du Pont de Nemours & Co., Inc., Polychemicals Dept.

Session III—Boats—Commercial and Naval

Presiding: H. L. Darby, Winner Mfg. Co., Inc.
Vice Chairman: Ralph Della Rocca, Gibbs & Cox, Inc.

"Statistical Design of Reinforced Plastics Data Program for Engineering Manuals," J. H. Gibbud and R. B. Wiley, Owens-Corning Fiberglas Corp.

"Molding Fiberglass Reinforced Plastic Boat Hulls in Matched Metal Dies," Lysle B. Gray, Molded Fiber Glass Co.

"Pressure Bag Molding of Reinforced Plastic Boat Hulls," E. F. Culwick, Winner Mfg. Co., Inc.

"Reinforced Plastic Landing Craft Learning Curves," Victor Todd, Lunn Laminates, Inc.

"The Fiberglass Boat Market," B. Cobb, Jr., Owens-Corning Fiberglas Corp.—END

mp Plastics

Production and sales figures in 1000 lb.* for July and August 1958

Materials	Total p'd'n first 8 mos. of 1958‡	Total Sales first 8 mos. of 1958‡
Cellulose plastics:[a]		
Cellulose acetate and mined esters		
Sheet, under 0.003 gage	11,549	11,114
Sheet, 0.003 gage and over	11,837	11,077
All other sheets, rods, tubes (including other cellulose plastics)	5,763	5,081
Molding, extrusion materials (including other cellulose plastics)	55,615	54,069
Nitrocellulose sheets, rods, tubes	2,056	2,232
Other cellulose plastics[g]	3,056[g]	2,209[g]
Phenolic and other tar-acid resins:		
Molding materials[a]	97,165	97,081
Bonding and adhesive resins for:		
Laminating (except plywood)	39,592	26,182
Coated and boded abrasives	7,845	6,867
Friction materials (brake linings, clutch facings, etc.)	7,560	7,243
Thermal insulation	30,493	30,547
Plywood	32,507	27,169
All other bonding uses	23,916	23,796
Protective coating resins	18,136	15,831
Resins for all other uses	19,096	14,869
Urea and melamine resins:		
Textile-treating resins	21,021	20,615
Paper-treating resins	17,114	14,961
Bonding and adhesive resins for:		
Plywood	59,040	59,792
All other bonding and adhesive uses, including laminating	26,764	24,393
Protective-coating resins	18,878	15,231
Resins for all other uses, including molding	57,034	55,456
Styrene resins:		
Molding materials[a]	263,177	280,261
Protective-coating resins	60,106	58,535
Resins for all other uses	99,151	79,623
Vinyl resins, total[b]	481,448	486,796
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		46,636
Sheeting (resin content)		39,346
Molding and extrusion (resin content)		128,282
Textile and paper treating and coating (resin content)		37,606
Flooring (resin content)		71,908
Protective coatings (resin content)		19,893
All other uses (resin content)		35,888
All other vinyl resins for:		
Adhesives (resin content)		31,075
All other uses (resin content)		76,161
Coumarone-indene and petroleum polymer resins	153,784	153,753
Polyester resins:		
For reinforced plastics	64,866	59,196
For all other uses	7,583	7,102
Polyethylene resins total:	548,387	507,257
For film		198,095
For all other uses		309,082
Miscellaneous:		
Molding materials[a,d]	26,217	26,712
Protective-coating resins[e]	10,053	5,446
Resins for all other uses[f]	93,443	81,200

*Dry basis designated unless otherwise specified.
†Revised.
‡Partially estimated.
[a]Includes fillers, plasticizers and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production are given. [c]Includes data for spreader and calendering-type resins

Production

From statistics compiled by the U. S. Tariff Commission

July†		August‡	
Production	**Sales**	**Production**	**Sales**
1,596	1,372	1,346	1,215
1,260	1,326	1,400	1,450
641	541	803	692
†6,911	†6,854	8,734	8,095
205	240	229	232
g	g	g	g
8,644	11,342	11,129	13,836
5,018	3,370	6,006	4,260
684	688	978	1,056
740	933	942	1,203
4,305	†4,707	4,236	4,400
3,953	3,131	4,956	4,166
2,674	2,758	3,312	3,222
1,517	1,791	2,868	2,143
2,459	1,941	2,711	2,287
1,808	2,053	2,705	3,122
1,822	1,859	2,687	2,402
7,871	7,914	8,845	8,566
2,880	3,151	3,880	3,558
2,717	1,928	2,420	2,342
3,559	5,162	7,011	7,111
30,066	30,986	33,946	34,379
8,434	7,748	7,242	7,289
10,923	9,294	13,253	10,641
†53,747	†58,582	68,492	70,872
	†4,796		6,594
	†5,330		5,547
	†15,520		19,286
	4,883		6,245
	†8,093		10,530
	2,526		2,810
	3,860		6,002
	†4,381		4,362
	9,194		9,497
19,016	19,715	22,545	23,180
7,796	6,806	6,905	6,778
1,166	1,085	925	932
70,035	62,774	68,064	70,046
	24,684		23,352
	38,090		46,694
3,373	3,210	4,123	4,246
1,623	840	1,845	743
11,015	10,024	11,567	10,469

[d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic rosin modifications, nylon silicone, and other plastics and resins for miscellaneous uses. [g]This classification discontinued in May and this material, mostly ethyl cellulose, reported in sheets and molding material.

Plastics Problem?

Get help in a hurry from your ***NEW*** *Encyclopedia Issue!*

EXAMPLE: ***Where and how to use resins and molding compounds?***

1. See the section "Resins and Molding Compounds" for all the fundamentals. Also see the materials charts and supplier lists in the "Technical Data" section.
2. Then check the Advertisers' Index—on the first page of the Resins . . ." section—for suppliers' ads on resins, coatings, emulsions, etc.
3. Secure additional names and addresses of suppliers from extensive Buyers' Directory lists in the back of the book.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. For more help, turn to the "Free Product Literature" section, select pertinent booklets and send for them with the enclosed free post cards.

EXAMPLE: ***How to color plastics?***

1. See the section "Chemicals for Plastics" for complete background.
2. Next, refer to the Advertisers' Index on the first page of the section for ads relating to your specific needs.
3. Check the Buyers' Directory for a detailed listing of suppliers of dyes, stabilizers, plasticizers, etc.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. For more help, turn to the "Free Product Literature" section, select pertinent booklets and send for them with the enclosed free post cards.

EXAMPLE: ***How to design a product—then get it made?***

1. Get the basic facts in the section "Engineering and Methods".
2. Then for molder and special service advertisements, see the Advertisers' Index on the section's first page.
3. Next, examine the Buyers' Directory for additional names and addresses of molders, extruders and service organizations.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. For more help, turn to the "Free Product Literature" section, select pertinent booklets and send for them with the enclosed free post cards.

EXAMPLE: ***Which machinery to buy?***

1. Turn to the section "Machinery and Equipment" for a complete picture of the factors involved.
2. Then see the Advertisers' Index on the first page of this section and select ads whose messages bear on your problem.
3. Get further information—names and addresses of machinery, machine tool and equipment manufacturers—in the time-saving Buyers' Directory.
4. Consult the Alphabetic Index for detailed cross-referenced listings of subjects related to your particular inquiry.
5. For more help, turn to the "Free Product Literature" section, select pertinent booklets and send for them with the enclosed free post cards.

The Encyclopedia is expressly designed to help you solve your problems. Reach for it next time you need help and see how valuable it can really be!

MODERN PLASTICS ENCYCLOPEDIA ISSUE

. . . for fast, accurate answers to plastics problems

EXPERIMENTAL PHOTOGRAPH BY WILLIAM RICHARDS

VINYLS new from Diamond

Diamond is new in all four... with more!

1 COPOLYMERS
New from DIAMOND – two developments in the growing field of copolymers: DIAMOND CR-80 for records and rigid film; and DIAMOND FCR for flooring.

2 PASTE RESINS
New from DIAMOND – in another fast-growing field: DIAMOND PVC-70 for the production of plastisols and organosols.

Diamond Chemicals

4 **COLD BLEND RESINS**

Also new in this year of remarkable growth for DIAMOND – an extremely versatile resin for solving difficult compounding and blending problems: DIAMOND PVC-60.

3 **U. L. APPROVED RESINS**

New from DIAMOND – two resins with superior processing properties for products that meet the high quality standards of the electrical industry: DIAMOND PVC-450 and PVC-500.

CONTROL PANEL FOR IBM ACCOUNTING MACHINE

Now here is the "MORE!"

When we said "DIAMOND is new in all four . . . with *more!*" we meant it.

"More" means a complete line of PVC resins and compounds that embody the best combination of processing characteristics and finished product properties.

It means a full staff of top technical salesmen backed by technical servicemen who are specialists in extrusions, calendering, molding and paste resin technology.

It means a new technical service laboratory that is now being constructed.

It means more for you . . . in products, in service, in technical facilities. It means that DIAMOND is a new force in vinyl manufacturing — flexible and dynamic, with a personal stake in your prosperity.

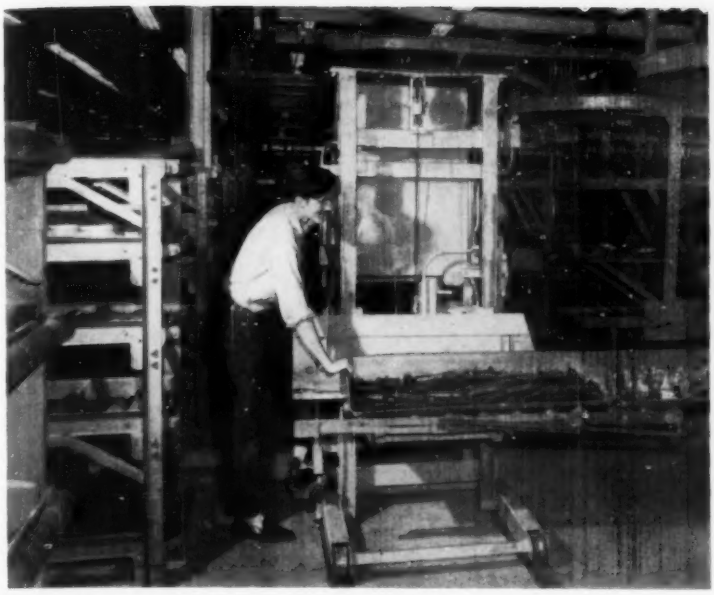
DIAMOND ALKALI COMPANY, 300 Union Commerce Building, Cleveland 15, Ohio.

Resin	Specific Viscosity	Applications	Main Advantages
PVC-500	1.63	Dry blend extrusions. Calendered film and sheeting. Wire insulation.	Rapid plasticizer absorption. Clarity and freedom from gel particles. U.L. Approved.
PVC-450	1.35	Dry blend extrusions. Calendered film and sheeting. Rigid applications. Wire insulation.	Rapid plasticizer absorption. Clarity and freedom from gel particles. U.L. Approved.
PVC-40	1.10	Calendering and molding. Semi-rigid sheeting.	High calender production rate. Good flow, heat stability.
PVC-35	0.85	Base for high gloss injection molding compounds. Processing aid.	Excellent flow. Improves processing without sacrificing heat stability.
PVC-30	0.63	Processing aid in molding and calendering.	Reduces temperature requirements and shortens production cycles.
PVC-25	1.10	Designed for unplasticized applications. Injection molded items or calendered rigid film and sheet.	Good flow and superior heat stability. Can be handled in standard equipment.
PVC-60	1.63	Supported and unsupported calendered film and sheeting. Extrusion.	High monomeric and polymeric plasticizer absorption. Cold dry blends.
CR-80 (Copolymer)	0.60	Records and rigid film.	High flow, low volatiles.
FCR (Copolymer)	0.63	Flooring.	Easy processing and high bulk density.
PVC-70 (Paste resin)	2.00	Plastisols and organosols.	Good clarity, viscosity, heat stability and shelf life.

Resin	Specific Viscosity	Applications
PVC-50	1.55	Calendered film, sheeting. General extrusions. Wire insulation (U.L. Approved).
PVC-45	1.35	Calendered film, sheeting, coated fabrics. Extrusion profiles, tubing, molding compounds.
PVC-FG (Resins)	0.63-1.35	Flooring.

A number of rigid and elastomeric compounds are also available for specific applications.

Diamond Chemicals



Transfer of reinforced plastic pallets from sub-assembly stores distribution conveyor to final assembly lines is accomplished with rail transfer car with automatic lift. The material mover can pick off any pallet from the sub stores five-level conveyors to transfer it to any of seven assembly lines

Conveyor assembly trays of reinforced plastics speed materials handling

Conveyor trays molded of reinforced plastics are simplifying and speeding assembly operations at the large Milwaukee, Wis., plant of Evinrude Motors. Evinrude uses great numbers of the specially designed trays as pallets to move parts and sub-assemblies of its outboard motors through the plant on a complex and extensive conveyor system.

The reinforced plastic trays are ideal for the application. They are light and strong, resist oil, grease, and water, will not shatter or dent, and are claimed to have unusual dimensional stability due to their design. The top flange is reinforced with an embedded wire rim for additional rigidity and strength. The trays will stand up well even when subjected to extremes in temperature.

Designed and molded by the G. B. Lewis Co., Watertown, Wis., the trays have rounded corners, smooth surfaces, and snagproof edges, which eliminate handling hazards and prevent damage to their contents.

Evinrude uses the pallets—they measure 45 by 19 by 5½ in.—to carry loads as heavy as 200 lb. through the plant. The trays are used as-molded to carry loose parts, and with custom-fitted inserts to hold sub-assemblies. The company reports that the new pallets handle more pieces with less time, less labor, and at lower cost than the tote boxes they replaced.—END

Complete sub-assemblies are carried by trays fitted with special custom-made liners. (Photos, Evinrude)

Foam package protects missile data

A molded urethane foam sphere with reinforced plastics skin has been found very successful in protecting delicate electronic equipment ejected from the Thor and Atlas missile nose cones. When retrieved, this data capsule provides space experts with valuable information.

One of the big problems in developing the data capsule was that of protecting the electronic gear against damage when the sphere is catapulted out of the missile nose by a rocket on reentering the atmosphere, and when it hits the ocean.

On impact with the ocean, the data capsule's outer hard protective shell of epoxy-fibrous glass laminate snaps open, permitting the urethane-encapsulated electronic equipment to float to the surface. At the same time, salt water activates a battery to fire a sound fixing and ranging bomb (Sofar), which then begins transmission of the radio signal.

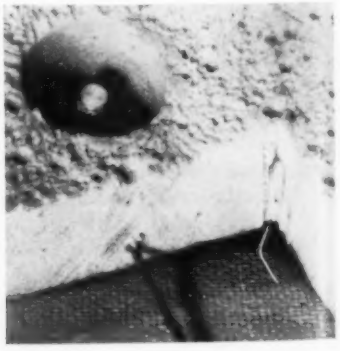
The inner part of the capsule housing had to be highly shock-absorbent. The impact when the sphere hits the ocean is approximately the same as for a car hitting a stone wall at about 100 m.p.h. In addition, it had to be compact, resist extreme variations of temperature, and offer long term buoyancy to keep the electronic gear afloat until found.

Urethane foam, using a special formulation based on Allied Chemical Co.'s Nacconate 80 isocyanate-castor oil adduct and a suitable catalyst to produce a semi-rigid foam having a density of 25 lb./cu. ft. met all these requirements. It can be easily molded to the exact shape needed, and is effective in encapsulating the electronic compo-

Antenna is secured to contoured wooden male mold, will later be embedded in urethane foam

After formulation is poured, male mold (right rear) is positioned and clamped down

Cured top half of data capsule is removed from mold. Sphere has 2-in. wall, 18-in. outside diameter



Foam has even cell structure. Embedded antenna lead (foreground) is connected to threaded stud

nents against moisture, heat, and cold.

The capsule is the result of cooperative effort of General Electric Co.'s Missile and Space Vehicle Dept., Philadelphia, Pa., which designed the unit; Standard Plastics, Inc., Breiningsville, Pa., which did the molding; and Isocyanate Products, Inc., Wilmington, Del., which developed the formulation.

The data capsule is assembled from two halves molded in contoured wooden molds. Except for one small variation, the outside of each half is perfectly spherical, so that the one female mold may be used for both halves. However, because of major differences in the internal shape of top and bottom segments two male molds are needed. Production of both halves is identical; except that an antenna is embedded in top part.

After the cavity is waxed, the formulation is dispensed into it—the amount is critical, since both density of foam and total weight depend on it. The male mold is then clamped down, and foam is cured for several hours at elevated temperature. After the cure is completed, additional quantities of the same formulation are used to embed recorder and transmitter and keep it rigidly in place, and to cement the two halfspheres together. Finally, two molded halves of an epoxy-fibrous glass laminate are affixed over the sphere in such a way that the seam is at a 90° angle to the foam joint. Clamps, designed to open on impact, hold the epoxy shell in place.—END

Assembled data capsule. Opening in front is for Sofar bomb which signals location of instruments

Custom molders

(*From pp.* 87-90)

new equipment. Already they have begun to realize that modern automation has a flexibility that is just as adaptable to small-run jobs as it is to the long-run, routine jobs of the captive plant. (See "The dollar value of automated thermoset molding," MPL, Aug. 1958, p. 85.) Chances also are that many of these new machines will not be cheap and it is likely that they will obsolete much of the equipment now on the market.

This may have two important results: 1) some current captive operations will have to switch back—even if temporarily—to custom molders; and 2) the need for larger capital investments may accelerate the trend towards the larger, more financially secure custom operations.

From all the foregoing, it is obvious that the custom molder is still on his feet and fighting. While some people feel that today's economics are such as to discourage the entry of new custom molders into the industry, it is just as true that the number of custom molders has—even in the past year—increased, rather than decreased. While some molders did merge, others seemed to spin off into smaller units set up by trained personnel who buy up segments of the original company's equipment and start out on their own.

Custom molding, in the words of one expert, "is like prospecting. Anyone at any time can come up with a handful of nuggets." When machines are operating at capacity, when the plant is humming all week long on three shifts a day—then, the profit picture is enough to entice anyone into the business. Even those fields which have done considerable switching to captive operation are still considered by some custom molders as "possible future markets." As an indication of this, they point to the fact that on a good share of jobs, these industries still accept bids from outside custom molders.

The brass ring is always there for someone who has the foresight, ingenuity, and ambition to reach out and grab it.—END

Rigid foams

(From pp. 91-94)

laid into a jig as shown in Fig. 4, p. 93, where hollow steel panels are being made ready for filling. The jig is then closed and freshly-mixed polyurethane is then metered into a hole left in the edge of the hollow panel (Fig. 5, p. 93) and the foam rises to fill the panel. A filling hole in a completed panel is shown in Fig. 6, p. 93.

Many different facings may be employed. Fibrous glass-reinforced polyester facings are used on the roof panels in Fig. 7, p. 94. In some of the panels, facings and core are translucent enough to transmit an appreciable amount of light (Fig. 8, p. 94).

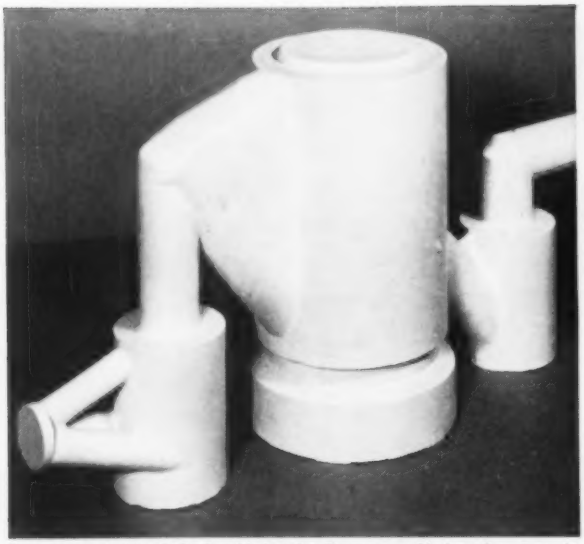
Other facings include plywood, aluminum, lignocellulose hardboard, cement-asbestos board, and reinforced concrete (see photo, p. 91) as well as the various combinations of these and similar materials.

Requirements for building

To be successful in building, any material must meet a number of requirements generally incorporated in building codes. Among the most important are safety, including fire and structural; durability; and competition from other materials.

Safety. Some of the considerations here are: Should a structure be noncombustible? Should the materials in a structure be self-extinguishing? Should the structure be designed to confine a fire to a given area and, if so, for how long? Are toxic or noxious fumes to be avoided?

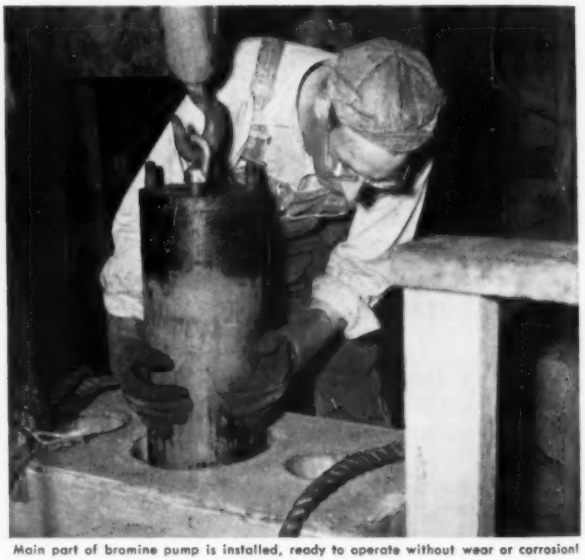
These questions all apply to plastics foams. In some ways the fire question is aggravated by foams with their large surface areas which tend to speed the rate of burning. When shielded from flames by a protective surface, such as the facing of a sandwich, foams may give an excellent account of themselves because of their low heat conductivity, and consequently may help to confine a fire. On the other hand, if the plastic foam core of a structural sandwich supporting a load should soften, it could easily lead to collapse of the



To shape the inside of the bromide-bromine liquor pump block, a form is made of plaster of Paris and Styrofoam®.

Dow Epoxy Resin 331 (casting formulation supplied by Ren Plastics, Inc.) is poured over the form and hardens.

The plaster of Paris and Styrofoam material in the form is broken up and removed.



Main part of bromine pump is installed, ready to operate without wear or corrosion!

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For years the main parts of bromide liquor pumps have been made with machined soapstone. Performance was inconsistent; the slightest crack or seam proved disastrous. But now Dow Epoxies open a new era of efficiency and economy for the chemical processing and corrosion fields. Easily cast to shape without costly machining, the epoxy pump blocks are impervious to the chemicals involved and free from the internal flaws of soapstone.

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sandwich and open a path for rapid spread of a fire.

Fire testing of plastics, including plastics foams, is still in a controversial stage. The small strip tests frequently used do not reflect the conditions met in a building fire, but some of the stardard larger-scale fire tests are believed by many to be unrealistic.

Structural safety is the second dominant factor in the development of building codes. For many applications, such as thermal insulation, foams are not required to have any particular structural properties. In structural sandwiches, however, the load-carrying ability of the sandwich depends on the strength of the core, as well as on the strength of the facings and the bond between facings and core. Strength must not only be adequate under the short-time loading tests commonly employed, it must remain adequate to sustain the loads during the entire life of the panel. There must be no creep leading to sagging or distortion of the panel, there must be no collapse of the foam causing the panel to become thinner and unable to sustain its loads. The structural integrity of the material must be maintained under all conditions to which the building is subjected during its life.

Costs. To be competitive, rigid cellular plastics must be able to compete in cost with other materials performing essentially the same function. Cost comparisons are exceedingly difficult and misleading unless specific cases are examined, because it is the in-place cost that matters. Approximate costs of several expanded plastics and other materials are given in Table I, p. 94.

These figures are useful as a starting point because they point out the relatively high per-board-foot cost of some of the expanded plastics when compared with other materials. In use, the costs of fabrication and installation must be added, and costs not immediately apparent must be taken into account. For example, a prefoamed slab, honeycomb, or board must be bonded by means of adhesives to the facings of a structural sand-

wich whereas a material foamed in place, if it has inherent adhesive characteristics, needs no adhesive.

Costs of various kinds of walls vary considerably. An exterior wall of a standard frame dwelling, depending on the materials in it, whether custom built or erected by a development builder or a prefabricator, may easily vary from less than $0.75 to $1.75/sq. ft. or more. Masonry may run from $1 to $5/sq. ft. Sandwich panels may vary from 50¢ and 60¢ to several dollars per sq. ft., not in place. The in-place costs of expensive panels on show-place downtown commercial buildings run as high as $10 to $11/sq. ft. The system of supports, closures, ribs, etc. into which a given panel is fitted has a profound influence on the in-place cost. Too often attention is concentrated on a panel alone, and the equally important system of erection is forgotten or improvised around the panel.

Whether expanded plastics are expensive or not in a given application depends, therefore, on many factors other than the per-board-foot cost. Nevertheless, there is a basic cost differential which must be overcome by ingenuity in the use of the materials.

Possible future developments

In most of the present or immediately projected uses of cellular plastics in building the plastics compete more or less directly with existing and well-established building materials, in many instances practically as direct substitutes or replacements. To do so they must be competitive, and in spite of higher per pound or per board foot costs they are often able to do so.

A close look at the properties and the processes for the manufacture of rigid cellular plastics may reveal advantages which have yet to be fully exploited. The ability to foam in place or to foam to any desired shape should offer many possibilities not available to some other materials. For example, there is a strong trend in building toward shells, folded plates, and other curved or three-dimensional

shapes capable of spanning long distances. Many of these are inherently strong and stiff structurally but to realize them is expensive. Concrete is usually thought of as the logical material for such structures, but the cost of forms for concrete, especially where labor costs are high, is often prohibitive. It is suggested that for many shell shapes, such as domes, lightweight prefoamed blocks could quickly be laid up igloo-style, or on relatively simple centering and supports, over which the reinforced concrete shell could be cast. The foamed blocks, in addition to acting as the form for the concrete, would remain in place to provide permanent thermal insulation (possibly sound-absorption also if sponge-like instead of unicellular). Evidently, also, sprayed-on facings of fiber-reinforced material such as polyester or epoxy would convert the foam into a sandwich shell.

An inflated form could be used over which sprayed foam could be applied to provide a dome-type structure. The inflated form would then be removed for reuse elsewhere. There are limits to the shapes possible with inflated forms but they offer some distinct opportunities.

High-density foam should be capable of providing a structural shell without a covering of sandwich facings or of concrete, provided the foam is protected by means of suitable coatings from prolonged weathering and erosion. This possibility is being actively employed by the Air Force and the MIT Lincoln Laboratories in connection with radomes some 25 to 55 ft. in diameter needed to house warning radars under arctic to tropical conditions. Here the electrical as well as the structural characteristics of the foams are important.

It is curious that relatively little seems to have been done to strengthen the various foams, without unduly increasing their density, by incorporating short-length fibers. It has been shown that cellular cellulose acetate could be markedly strengthened in this way, but little appears to have been done to make use of this possibility.—END

PE cartridges

(*From p. 95*)

were the deciding factors. In addition, its high finish and low coefficient of friction resulted in a very smooth and reliable action.

The often objectionably low stiffness of plastics, as compared to the metals, was an advantage here. Under the high internal pressure, the casing expands momentarily, making a highly gastight seal between itself and the barrel. (Metal trounds couldn't do this.) This means higher and more consistent bullet velocities, with greater accuracy and punch. The fired shell is as good as new, amazingly unmarked by its brief exposure to the 3000° F. flame temperature. The springiness of linear polyethylene is useful in other ways, too.

Whereas metal casings must be fitted precisely to the bullet, and even then are not watertight, the bullet in a tround is held snugly by an elastic press fit. Cases can be reloaded repeatedly without being resized. Trounds can't chip or dent, they function perfectly at all temperatures, they are said to resist all corroding substances, and will fire reliably after long soaking in water.

Inside each tround, which is diagrammed on p. 95, is a tiny polyethylene disk dividing powder from bullet. This disk prevents the escape of gas past the bullet before it is solidly engaged in the rifling of the barrel.

The trounds are adaptable to a great variety of powder loads and bullet weights, can even be molded to hold ordinary cartridges. All calibers will use casings of the same outside dimensions, of different colors, so the pistol can be converted from 0.22 to 0.38 cal. by simply swapping barrels—a 5-sec. operation. It is estimated that center-fire tround cartridges will cost a little less than their brass equivalents.

Some gun experts believe that the new pistol and its polyethylene trounds will make all other handguns obsolete. In view of the success of plastics in both these cartridges and the 105-mm. shell, thought is now being given to the use of plastics for standard small-arms casings.—END

Polyethylene

(*From pp.* 98-102)

high-density resin (Conolex film) for paper napkins showed a saving of 40% over cellophane when 1¼-mil film was used, 48% when ¾-mil was used and 13% over conventional polyethylene.

He called Conolex the film with a built-in tear tape—a printed line would replace the tear tape on cigarette packages. The reason is that the molecules in linear polyethylene are in long, straight chains lined up longitudinally in the direction of extrusion. The tear can be started at a notch and is straight and true. The strength of the package is no more impaired than in cellophane, since the force required to propagate a tear at the notch is greater for Conolex than for cellophane, according to Mr. Hewitt.

To sum up the differences between low and medium-to-high density resins, it might be said that as density goes up the film becomes stiffer but tear and impact strengths decrease. The high-density linear films are not yet perfected to obtain both good clarity and high burst strength in one film, but the quenching process is expected to cope with the clarity problem and better burst strength is foreshadowed as a result of laboratory experimentation. But greater high-temperature resistance, better resistance to water vapor and gases, more resistance to grease and better abrasion resistance result from higher densities. Despite all those good properties of medium- and high-density film, there is very little film now on the market made from 0.930 density and up, but significantly enough there is an estimated ½ million lb. a month of 0.929 film being consumed. Early entrance into the field of low-density material, its toughness and inertness, low cost, and ease of processing have given it a market that is not likely to be surpassed for many years.

Methods of making film

One of the interesting developments in film production in 1958 has been the widespread interest created by so-called "cast" film. The word "cast" is somewhat of a misnomer since the word "cast" in the plastics industry has always implied use of a solvent, a monomer, or a melt. What the polyethylene industry is talking about when it refers to "cast film" is extrusion of the film from a slot die onto a chilled roll instead of the large bubble which has been more prevalent to date. A more appropriate name might be chilled-roll film.

Bubble, blown, or tubular extrusion has been by far the most prevalent method for producing film to date. It seemed to be easier, was faster, and producers were so busy that they didn't have time to experiment with other methods. But efforts to obtain more clarity and gloss in conventional film and the difficulties involved in handling linear polyethylene on blow-extrusion equipment led to experimentation with interesting results in chilling.

Advocates of blown-extrusion still insist that it is most practical for conventional polyethylene in densities of around 0.920 and perhaps higher. They feel that it gives better gage control, is faster, produces less waste and gives better balance of properties.

In conventional blown film the rate of cooling is slow and thus raises density of the finished film to make a weaker film from an impact viewpoint. The size of the bubble unquestionably affects such properties of the film as strength and clarity; but conflicting opinions indicate that knowledge on this point is completely confused except for the one factor that a higher blow-up ratio produces a tougher film.

However, it is generally conceded that, when the film is chilled by a water bath or cold roll immediately after slot-die extrusion, it will be glossier, have better optical properties, and will be tougher than blown film because the fast quenching or chilling will hold down the density of the film. The basic toughness depends on density of the resin used—the lower the better.

The surface of conventional film is improved by fast cooling because the spherolites in the polymer are kept small and there are fewer of them. Big spherolites result from slow cooling and

make the film less clear. The chill, in preventing formation of big spherolites, is what holds down density of the film and assures a tougher film than in blown film made from the same formulation. An ideal resin for chilled film might therefore be a bit higher in density and MI than for blown film, to provide better clarity.

The efficiency of water bath vs. chilled roll extrusion is still a matter of opinion, but chilled roll for conventional PE and water bath for linear PE seem to be gaining in favor. In the water bath method for conventional PE, the slip additives used tend to make the film hydrophilic and thus cause the water to ride along with the film and force the wind-up of a wet film which is undesirable. Film made from linear resins does not require slip agent, since it has a harder surface and less tendency to block during the wind-up. Since there is no slip agent in it, the water has no tendency to "stick" to the film and it comes out of the bath comparatively dry.

The chilled-roll method is similar to the polyethylene paper coaters' operation. The film from the die is extruded directly on to a chilled roll and the spherolites in the hot film are quickly frozen to prevent their enlargement. A properly designed chilled roll will take the heat out of a film faster and more uniformly than water, according to its proponents. For that reason there are some producers who recommend it for high-density linear film, but another producer says water quenched linear film will be clearer and he has already run it as fast as 375 ft./min.

At present blown film can be produced at around 200 ft./min. for 1½-mil film, which is faster than chilled film. Paper will go 1000 ft./min. by this method; and experimental runs on 1-mil PE have been made at 800 ft./min.

It is far too early to predict how much of the conventional film market will be eventually produced by the flat-die, chilled method, but it is a likely prospect for most of the film that is to be used for wrappers and wherever strength in one direction and weakness in the transverse direction are desirable or tolerable. After all, flat die film has been available for years but the roll therefrom was often subject to "pucker" and "belly." Furthermore producers of blown film are improving their technique every day and can show good clarity, gloss and stiffness by using a 0.927 density resin that may well prove stiff enough to compete with higher density resins on wrapping machines.

Coating resins

Polyethylene resins for coating on paper, cellophane, and foil are just as variable as those for molding and film, but only a few are the real work horses of the industry. Some suppliers frequently list a coating resin as also suitable for unsupported film, sheeting, and other purposes.

The type of resin used depends, even more than in other categories, upon end use. Generally speaking, a coating resin must flow rapidly and is thus likely to have an MI as high as possible but still low enough to give good gage control.

A resin density of from 0.917 to 0.920 with an MI varying from 2.7 to 3.6 is suggested for coating paper diapers. It must be extruded fast and be of such viscosity that it will flow into the interstices of the paper and become securely anchored. For the liner of a multi-wall bag a density of 0.923 with an MI of 4 or less could be used to give good substance, good adhesion, and better barrier properties.

If polymer-coated cellophane has to be heat sealed when in use, a resin density of around 0.916 to 0.918 is suggested because of its lower softening temperature—the polyethylene must be melted without ruining the other layers of material.

When extra good grease resistance is required the density of the resin required is higher. Medium density producers generally sell a special formulation for this purpose. It ranges in density from 0.930 to 0.935, with melt indices that vary from 1 to 3, depending upon how stiff a coating can be used. This type of coated paper is used for the government's food

(*To page* 202)

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INJECTION MACHINES. Illustrated catalog gives design and performance features of a line of injection molding machines which range in capacity from 4 to 32 oz. Reed-Prentice Div., Package Machinery Co. **(L-829)**

EXTRUDERS. 6-page illustrated brochure describes a line of electrically heated extruders with capacities from 2 to 10 inches. Machines feature high, accurately zoned operating temperatures. John Royle & Sons. **(L-830)**

PLASTISOLS. Series of data sheets discuss the application of this company's plastisols as insulation, for proofing fabrics, for decorative and protective coatings; and for dipping wire goods, tool handles, marine equipment, etc. Stanley Chemical Co. **(L-831)**

RIGID POLYURETHANE FOAM SYSTEM. Technical bulletin describes a rigid polyurethane foam system, used in the manufacture of plastics foam products and in-place foaming operations. Gives features, uses, product characteristics, applications, etc. Reichhold Chemicals, Inc. **(L-832)**

ELECTRONIC SEALING AND HEATING EQUIPMENT. Series of bulletins describe a line of machines for the electronic welding of rainwear, shower curtains, baby pants, tobacco pouches, inflated toys, handbags, upholstery, etc. Thermatron Div., Radio Receptor Co., Inc. **(L-833)**

FILTER DUST COLLECTOR. 4-page brochure describes a suction-type, tubular cloth filter collector featuring a housing constructed of aluminum, and an automatic cleaning mechanism. Entoleter Division, The Safety Car Heating & Lighting Co., Inc. **(L-834)**

HYDRAULIC PRESSES. 4-page illustrated brochure describes hydraulic presses for molding, molding and laminating, polishing and laminating, embossing, and laboratory use. R. B. Wood Co. **(L-835)**

FLUOROCARBON PLASTICS STOCKS. 12-page catalog describes available teflon and Kel-F beading, extruded and molded rod, sheet, molded sleeves, electrical spaghetti, tape, and tubing. Plastics Div., The Garlock Packing Co. **(L-836)**

COMPRESSION MOLDING PRESS. 4-page illustrated brochure describes a 25-ton automatic compression molding press, designed for applications where short production runs and frequent job changes do not warrant tooling for a higher production automatic press. Plastics Equipment Div., F. J. Stokes Corp. **(L-837)**

HOPPER-DRYER AND LOADER. 4-page illustrated brochure describes a hopper-dryer and automatic loader unit adaptable to any type of injection or extrusion machine setup. Unit permits uniform drying and preheating of material. Loader requires no compressed air source. Thoreson-McCosh, Inc. **(L-838)**

VINYL RESINS. 4-page illustrated brochure describes advantages of this company's vinyl resins in the manufacture of toys, skins for bouncing horses, doll carriages and tops, foam plastic items, etc. Naugatuck Chemical Div., United States Rubber Co. **(L-839)**

VALVES. Catalog gives design and operating features of a wide variety of hydraulic, steam, and air valves. Sinclair-Collins Valve Co. **(L-840)**

POLYETHYLENE PROCESSING. File folder contains booklet with information on the processing of polyethylene; also booklet with data on the heat-seal characteristics of polyethylene films. U.S. Industrial Chemicals Co. **(L-841)**

EXTRUDER USE SURVEY. 6-page illustrated brochure surveys the use of the Reifenhauser "S 150" extruder in the manufacture of pipes, tubes, rods, extruded sections, tapes; insulation for electrical wires and cables up to the largest diameters, etc. H. H. Heinrich Co. **(L-842)**

HOT STAMPING MACHINES. Illustrated catalog describes a line of air-powered hot stamping machines designed to mark up to 1,500 or more parts per hour. Machines mark tappered, conical-shaped and other types of dials, gages, and parts requiring calibrations; tube bases, etc. The Acromark Co. **(L-843)**

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pack. It can also be used for unsupported film and has a dead fold like cellophane and paper. When used for wrapping lettuce, it doesn't unravel or come loose in the twist that holds the film in place at the top of a head of lettuce.

A 0.935 density resin is now being tested as a coating on paper for boilable food pouches that contain precooked foods. Another development is a coating on multi-wall bag paper for ammonium nitrate where it was found that the coating thickness could be reduced by 25% when using 0.935 density resin without sacrificing any protection. If the thickness is below 1 mil, it is difficult to avoid paper fiber wicking, pin holes, etc.

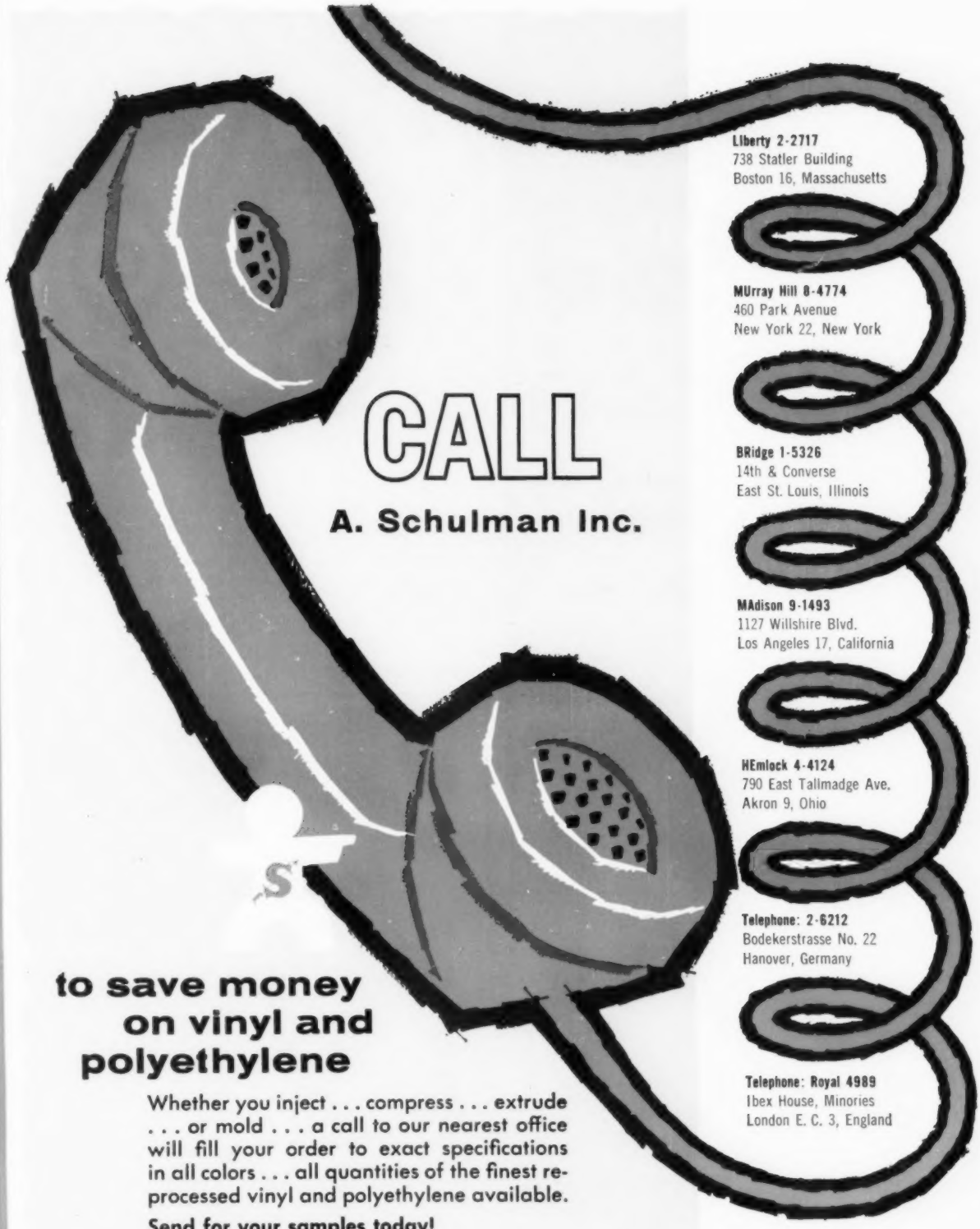
Another type PE used for coating is a very-low-molecular-weight highly branched material that has a specific gravity of 0.907. It is a melt coat and is applied from a fountain with an applicator roll. It is highly grease resistant and provides an excellent heat sealing surface because of its low temperature melting point and fast cycle. This material is used primarily on short runs and specialty materials, such as underpads for cakes and candy to prevent sticking. Another use is for attaching paper labels on bread wraps to polyethylene film. It sells for 39¢/lb. Another variety of this material is used to upgrade paraffin used in wax coatings.

So far there has been little high-density resin used for coating, but producers expect to enter the field soon. One of them is optimistic enough to set a goal of 80 million lb. of high-density resin for coating in about 1960.

A market analyst for another producer says that a total of 100 million lb. of all grades of PE will be used for coating three years from now. Foodstuffs alone, led by PE coated cartons for milk, frozen food, cereals, pouches for precooked food, and butter cartons, are expected to take most of it.

• • •

Part III of this article, dealing with pipe, wire coating, and monofilaments, will appear in an early issue of *Modern Plastics*.



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New resins

(*From pp.* 103-104)

and alloys of the higher-density polyethylenes will in the future introduce important additional values, such as more uniform shrinkage, greater transparency, and added resistance to environmental stress cracking.

Diallyl phthalate (DAP)

A new diallyl phthalate resin (*Dapon*, Food Machinery and Chemical Corp., compounded and sold by Acme Resins, Durez, and Mesa Plastics) provides some interesting and valuable opportunities for "wet-inside-dry-outside" application. The material has a high degree of color stability with no distortion or color change reported after 48 hr. at 350° F. Other important properties include non-staining of inserts, arc resistance, low loss, improved dimensional stability, high gloss and resistance to thermal shock.

Orlon-filled DAP (Durez Plastics Div., Hooker Chemical Corp.) is gaining new markets for high-humidity electrical applications; a glass-roving-filled variety has very high impact strength.

Acrylic resins

A new acrylic resin, now in the development stage, is reported as having high temperature stability and will withstand boiling without loss of transparency, color, or dimension.

A modified acrylic resin for injection and extrusion is now being offered (*Implex*, Rohm & Haas). It is characterized by improved toughness without loss of colorability and gloss; it contains no plasticizer and is widely used for shoe heels because of its clarity and nailability.

Polycarbonate resins

The polycarbonate resins (e.g., *Lexan*, General Electric) are becoming increasingly available and have satisfied a number of unusual programs. The creep resistance of Lexan at 210° F. is reported to be equal to that of nylon at room temperature! Dimensional stability, improved impact strength, and heat resistance up to 300° F. are other properties. Typical applications include gears,

bottles, electro-mechanical components, battery cases, cams, etc. (See "First polycarbonate applications," p. 96 of this issue).

Phenolic materials

The Bureau of Ships will issue a new specification on a phenolic-asbestos compound for flame- and arc-resistant applications designated as Type MFA-30 in the new specification No. MIL-M-21156 (Ships). This is expected to end many of the serious production problems associated with the old melamine compounds that are presently specified, and it is good news to the molders of plastics.

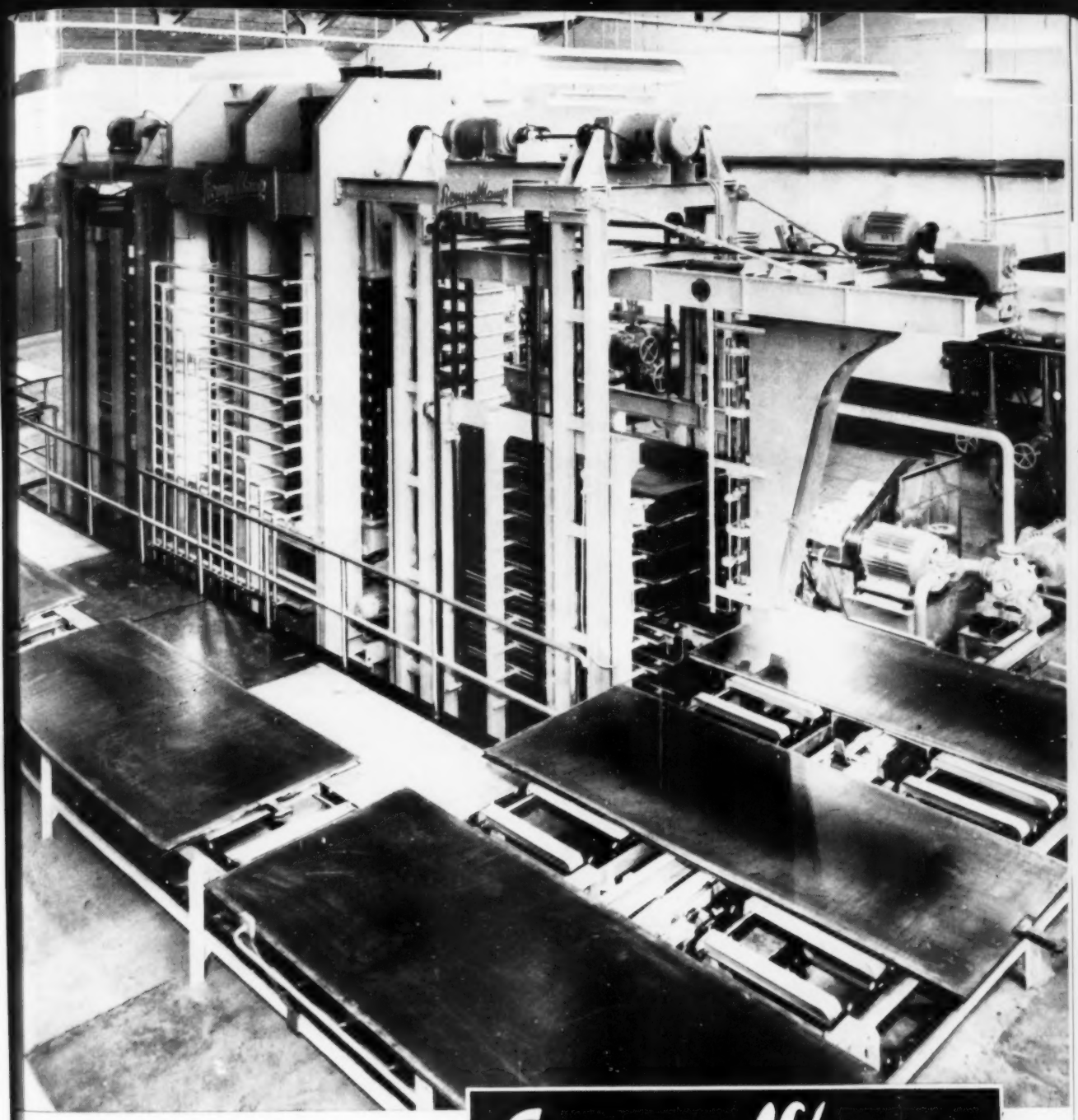
Sisal-filled phenolics (Durez Plastics Div.) are gaining good acceptance as a replacement for rag stock materials and certain polyester-glass premix compounds. This is an inexpensive material that may be molded at low pressure in cast-steel molds. It is being used in meters, oil-well plugs, auto-heater housings, air-conditioning components and may be employed in the "wet-inside-dry-outside" applications where conventional phenolics fail.

The glass-filled phenolics are gaining new market acceptance in the automotive field. Typical applications are the Chrysler oil-pump gear, where it has outperformed die-cast aluminum.

A modified phenolic (*Fiberite 4035 natural*, The Fiberite Corp.) with glass fiber reinforcement is performing well in a number of very critical applications that require best dimensional stability, minimum thermal expansion differential, high strength, and heat stability. It is particularly suited to the molding of missile and aircraft components which require complex insert assemblies that must maintain tightness over a considerable temperature range.

Silicone resin

A triangular silicone rubber tape with an included guideline (Moxness Products, Inc.) provides an impermeable, high temperature electrical insulation for large motors and generators. There is a real change-over to silicone in this field and it is expected that all large motors will be silicone-rubber insulated in



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the very near future. The silicone insulation adds resistance to ozone, moisture, heat, vibration, and shock.

Epoxy resins

An improved, high-strength, controlled-dielectric constant, epoxy-resin foam with self-extinguishing and flame resisting characteristics is now in production (D & R Pilot Plants, Inc.). These foams are outstanding in their dielectric constant uniformity, dimensional stability, and in their controlled density and texture. The aircraft and missile manufacturers are making excellent use of this epoxy foam.

Epoxy molding compounds with good and fast molding properties are reported ready for marketing by several companies.

A tough, epoxy-based enamel with very high bond strength to molded phenolic compounds is now offered (Rexton Finishes, Inc.). It is available in a glossy finish or in "zero gloss" for the nonreflective coatings needed in cameras and for instruments. Adhesion is good, even to very high gloss "as-molded" phenolic surfaces.

Styrene

Expandable polystyrene beads (*Pelaspan*, Dow Chemical Co., and *Dylite*, Koppers Co.) are finding some most interesting markets in foam-in-place applications. The beads contain an expanding agent and when confined in a retaining mold and heated, they expand to form a rigid cellular product. Typical applications are hot-fluid drinking cups, thermal insulation, buoyancy, low density filler, sound and shock absorption. Very substantial markets are expected in refrigeration. (See "Rigid plastics foams in building," p. 91, this issue.)

Market studies indicate new and more extensive uses for the high-impact styrene materials. There appears to be little or no changeover from polystyrene to other materials at this time. A graft polymer (Foster Grant) used for some styrene toys is making an excellent showing in comparison with some high-density polyethylene toys.

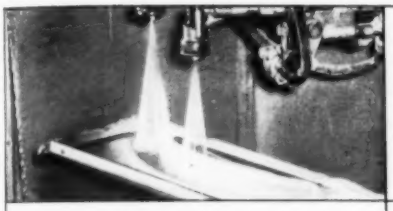
New flame-resistant styrene materials are coming along which

Cut masking time and costs to a fraction

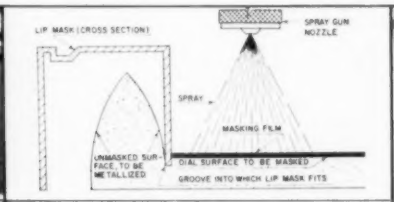
SIMPLE DESIGN FEATURE ALLOWS
AUTOMATIC SPRAY-ON, STRIP-OFF MASKING

A simple design feature incorporated into your molded plastic parts—a ridge or groove to separate masked from unmasked areas—lets you take advantage of a revolutionary new automatic masking process. The mask—Spraylat SC-1075 — is a liquefied compound that sprays on areas to be shielded, dries to form a tough protective film, and peels off when decorating is complete.

IT'S SO FAST, a single unskilled operator can mask over 200 of your most complex parts per hour for decorating or metallizing. The diagram shows how. The ridge or groove permits a metal lip mask to be fitted to the part, shielding from spray the areas where decorating should take. One lip mask—easily made from your part or mold pattern — is all that's required.



A complex speedometer dial is masked for metallizing in less than 5 seconds. Spraylat coating is sprayed onto dial face through window of stainless steel lip mask.



The secret is the groove around rim of dial face into which lip mask fits snugly. This gives razor-sharp break between masked areas (to remain clear) and unmasked portions (to be metallized.)

Mask of Spraylat coating is peeled off dial after it has been enamelled and metallized.

For help or suggestions in designing your product to take advantage of this money-saving process, write:

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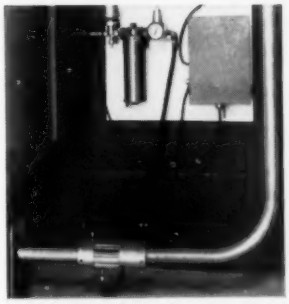

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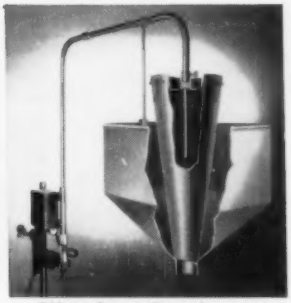

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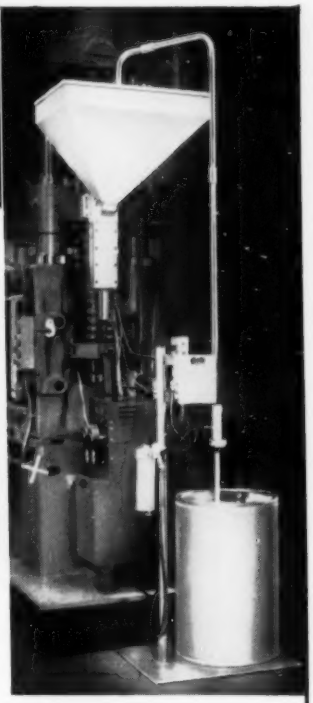

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will open more of the appliance and business machine markets to styrene compounds.

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For properties of individual materials, see chart facing p. 590, Modern Plastics Encyclopedia Issue (1959).—END

Rigid vinyl

(*From pp.* 106-109)

thing else, but to find a spot where vinyl will perform a service not heretofore available.

Rigid vinyl shapes have unlimited possibilities for the extruder who has imagination as well as mechanical ability. Take electrical conduits for example. A vinyl conduit is easier to install than metal, its electrical properties are superior, and it is resistant to chemical fumes or liquids.

A Florida power company is using rigid polyvinyl extruded conduit for underground installation. The smooth interior will not corrode and will make it easy to pull wires through the conduit in years to come.

There are scores of other uses for extruded shapes. U-shaped channels serve as insulators for naked wires on an overhead power lift and make it possible to install three to 12 power lines close together where space is tight. PVC links on a continuous belt are not abraded by the constant friction of moving parts and will resist chemicals in textile plants. Rigid vinyl runners for bowling ball return tracks reduce noise and eliminate wear on bowling balls. Scuff-resistant moldings and strips in autos can be colored to match the color scheme and are unaffected by trapped moisture around glass areas. Shaped strips hold carpeting in place under doors and resist the grinding abrasion of dirt.

A rigid vinyl window frame and sash are now in production. In other applications, window tracks and frames are lightweight and permit easy soundless operation. These window tracks are especially promising, with each window using 10 ft. of track. Some 1,000,000 new homes a year are prospects for this item. At least one manufacturer of storm doors and windows is making a complete vinyl frame and sash. Others are using rigid vinyl components.

High-impact rigid vinyl is used to make a moisture eliminator baffle for large industrial air conditioners that is unaffected by moisture-laden air and eliminates the necessity for elaborate supporting structures. This particular application is already in rather wide usage.

Tracks and thresholds of rigid vinyl assure efficient and quiet operation of sliding doors for closets and cabinets. Architectural moldings to hold ceramic tile in place and edging for work counters are now in use. Plating tanks are lined with rigid PVC. An extruded duct simplifies installation of switchboards, instrument panels, and electronic systems and permits wires to be led out from the main channel through evenly spaced perforations. Functional and trim strips are used for radios, television cabinets, air conditioners, and cameras. Baseboard outlet strips and tubing of various types allow contact at any point along the strip.

Perhaps the greatest potential of all is for siding on buildings, downspouts, gutters, and even roofing. But these applications have not progressed far enough to

make an estimate of their future at the present time.

A new development in the extrusion of rigid vinyls is a flat die with which a $\frac{1}{8}$-in. thick by 48-in. sheet of rigid vinyl can be extruded. Thicker sheets than this have been extruded from unplasticized vinyls but not in such a wide width. The common method for obtaining a thick sheet has been by laminating calendered sheeting; but the prospect of extruding $\frac{1}{4}$- or $\frac{1}{8}$-in. thick sheet in wide widths could well broaden the market, since it improves on the costly process of laminating one sheet to another.

The subject of calendered rigid vinyl sheeting has not been stressed in this article because its future is not as perceptible. Today its volume is far ahead of extruded rigid material.

Copolymer sheet

Relief maps, which were the first large-scale vacuum forming application, are made of unplasticized vinyl copolymer sheeting and now use hundreds of thousands of pounds of resin a year.

Other applications for vinyl copolymer material include vacuum-formed signs and displays, which used an estimated 1.5 million lb. in 1956 and are expected to grow to 2.5 or 3 million by 1962.

Toys and novelties accounted for from 1 to 1.5 million lb. of unplasticized vinyl copolymer sheeting in 1956 and may add a million to that volume by 1962.

Building structures such as partitions are a good potential for rigid vinyl sheeting, but so far haven't developed to any great extent because of tough competition from other materials.

Then there are scores of uses for printed and embossed vinyl copolymer sheets, such as credit cards, book bindings, playing cards, milk bottle caps, measuring instruments, templates, etc.

All these markets together for copolymer rigid vinyl calendered sheeting in 1957 were thought to consume between 13 and 15 million lb. of resin. Most estimates for 1962 put volume at around 20 million lb. although there is always the possibility of one big application which would raise the figure by several millions.—END

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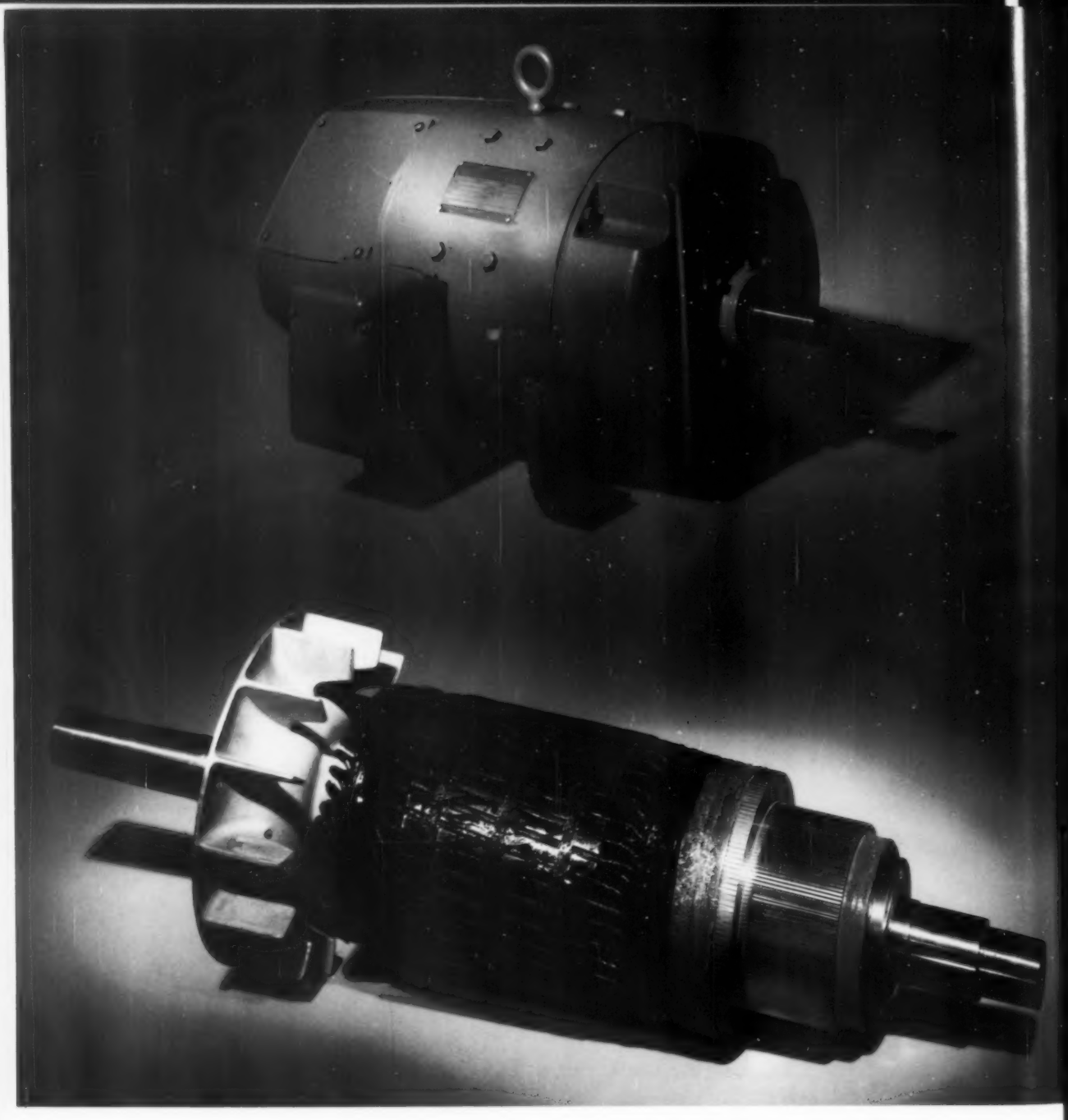

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Premix scores

(From pp. 110-111)

each corner of the base. Steel pivot pins for a spring-loaded double roller arm of the switch toggle mechanism are inserts in ¾-in. bosses molded integrally into base. A thin vertical ridge molded into the base mates with a slot in the quick disconnect plug, helps seat the plug firmly, prevents excessive stress on the primary posts, and increases the electrical creep distance between the posts. Since all current-carrying parts (i.e., switch contacts and primary posts) are set directly into the plastic base, they are automatically isolated from each other without the need for individual insulating pieces.

The cover for the tap switch base is designed especially to prevent seepage of water, moisture, or dirt into the switch. The recessed center portion of the cover, in which the switch handle rotates, is channeled out to the four corners to drain off splashes or condensate immediately. All horizontal surfaces of the cover are pitched downward to facilitate drainage. The interior is further protected against leakage by a ⅛-in. raised rim around the top of the switch shaft opening and by a shoulder at the base of this opening for seating a neoprene wiper strip.

Body parts withstand heavy loads

The main structural support for the entire transformer assembly is provided by two rectangular body moldings. About ⅞ in. thick and 2 in. deep, they form a frame which sustains not only the weight of the transformer (when suspended from the threaded mounting holes) but also the much higher dynamic loads occurring in service. For example, nearly the entire physical shock of the heavy primary-secondary assembly, as it reacts to the surge of current at the beginning of every welding cycle, is concentrated in the small corner areas of the body parts.

Several tests were conducted on the strength of the polyester parts in the complete assembly. In one case a ½-in. eyebolt was screwed into one of the mounting holes of the body molding and a 3000-lb. dead weight was suspended from the diagonally opposite hole without affecting the part. As for flexural strength, an assembled 50 KVA transformer (weight 134 lb.), suspended only from the two mounting holes in the front body molding where the leverage forces are highest, was subjected to 20,000 cycles of a 4-in. free fall with no damage whatsoever to the plastic part or threads.

Comparative tests

Thermaflow 100 was selected after careful comparative tests with other materials. It was found to have the best combination of high impact, compressive and flexural strength, good electrical insulation properties, and excellent chemical resistance, including oils, grease and water. The material also had to satisfy heat resistance requirements compatible with an 85° C. rise in Class B service and a 130° C. rise in Class H service. Parts are molded for Kirkhof by Grand Haven Plastics, Grand Haven, Mich.

The molding properties of the polyester molding compound—with respect both to the intricate detail which can be precisely reproduced and to the excellent surface finish which is obtained on the molded part without additional finishing steps—are decidedly reflected in the cost of manufacturing the redesigned transformers. It had been anticipated that the all-dielectric construction would be more expensive because of high mold costs and the somewhat higher cost of the molding compound as compared with aluminum castings. But the fact is that the final manufacturing cost of the transformer is no higher than the cost of the unsealed aluminum predecessor. The savings in machining and assembly time obtained from the use of molded parts, particularly in the tap switch, have completely wiped out the initial higher cost on a per part basis. Thus, some radical improvements and innovations in transformer design have been made possible without affecting the final cost of the equipment.—END

Surface erosion

(*From pp.* 135-150)

faces are generally extremely rich in glass. The sunken strips noted running diagonally across the specimen in Fig. 7, p. 148, are made up of pockets in the laminating fabric formed where warp yarns pass under fill yarns. These strips may be discontinuous and form diffuse pores or may be present as a meandering channel.

The preimpregnated fabric under molding conditions does not contain sufficient resin to fill these surface voids.

In some cases the resin was sufficient to cover the yarns in the bottom of these sunken areas but in others the fiber was still visible. Where the surface is not resin starved, the sites of the yarn apices are present in relief and are as easily visible as those in Fig. 3. Other laminates had surfaces that were almost uniformly covered with fibers or their relief images and at higher magnifications had the microstructure shown in Fig. 8, p. 150. The phenolic laminate having the lowest resin content, 23.5%, also displayed the roughest surface; as shown in Fig. 9, p. 150, the flattened fill yarns are clearly visible in the broken, thin layer of surface resin. The condition of this surface, however, cannot be attributed to the alternate wetting and drying since the unexposed surface was almost as disrupted as the surface after cycling. One phenolic laminate, which had the highest resin content in this group, had a surface equivalent to those found on the average polyesters and showed about equal resistance to the decontamination process.

As a group the molding compounds were poorer than the laminates in their resistance to surface erosion. One compound consisting of phenolic resin with nylon flock filler was outstanding in its resistance to the stresses of wet and dry cycling. Two samples of a melamine compound with chopped-cotton-fabric filler showed comparatively little surface damage after exposure to the 50 cycles of wetting and drying. Damage, however, was severe in most samples with glass or asbestos fillers. In Fig. 10, p. 150, the cracks extend from superficial glass fibers; cracking also takes place along the periphery of the surface fibers. The surface defects here are quite gross and some cracks can be detected without visual aids. Many of the large cracks gave off threadlike branches.

Molding compounds with organic fillers all gave surfaces with the underlying fibers easily visible just under the surface. After the 50 cycles of wetting and drying the fiber-rich surface areas showed some mechanical breakdown. In the worst cases the thin layers of surface resin covering the filler elements spalled from the sample, baring portions of fiber as in Fig. 11, p. 150. More commonly, however, cracks parallel to the main axis of superficial fibers are formed. At high magnifications most of these are found to have the compound crack formation shown in Fig. 12,

p. 150. Each crack can be seen to be composed of a number of fissures running transverse to the main crack axis. At the macroscopic level a definite color change was observable in most of these materials (Table V), which may be linked to some change in optical properties of the eroded surfaces but are also probably due to changes in the resin itself.

Some conjectures on the mechanism underlying surface erosion may be made on the basis of these observations. In the case of the molding compounds containing organic fillers, it appears likely that sufficient water enters the fillers to cause swelling and localized stress fields. Whether this moisture permeates the resin in the form of vapor or enters as liquid through faults in the surface cannot definitely be ascertained. However, it is known that such faults can sometimes be detected in the microstructure and that the resins do have a small but measurable vapor permeability. The resulting stress causes failure in the thin film of resin covering the filler elements and is evidenced by cracking, spalling, and chipping of the surface.

In the glass-filled compounds the surface failure mechanism is somewhat less obvious. The observation that most cracks occur along the fiber peripheries is indicative of primary failure in the glass-resin bond. These adhesion failures would cause local stress concentrations that lead to surface cracking.

Protection of the surface

The most obvious recourse to avoid surface erosion is to protect the susceptible surface, especially the filler-rich layers, from contact with moisture. A sheet of polyethylene terephthalate film was cut to the dimensions of the laminating fabric, placed over the mold contents, and the top platen applied. After curing, the adhesion of the polyethylene terephthalate to the polyester resins was found to be poor. However, the film adhered to epoxy resin panels and the bond showed no sign of failure after the 50 cycles of wetting and drying. The polyethylene terephthalate film itself did not erode. Sheets of 0.010-in.-thick aluminum sheet and 0.024-in.-thick stainless steel sheet were applied to glass fabric preimpregnated with epoxy resin. After the resin was cured, the adhesion of these sheets to the substrate laminate was found to be excellent. There was no significant loss of bond strength after the decontamination procedure cycling. Unfortunately, the postforming of these sheets does not appear to be practical and even slight draws and simple shapes would require the use of preformed overlays.

Increasing the resin content effectively produces a gel coat which also increases the resistance of polyesters and epoxies to erosion. Thin synthetic fabrics composed of nylon or acrylonitrile copolymers can be applied to the surface, impregnated with the resin, and cured. The resulting layer is essentially a gel coat reinforced by the well-bonded synthetic fibers.

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The Plastiscope

News and interpretations of the news
By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 37)*

Union Carbide Plastics has new sales structure

A new alignment, designed to help the company keep in close contact with individual customer's needs and desires, has been evolved by Union Carbide Plastics Co., formerly Bakelite Co.

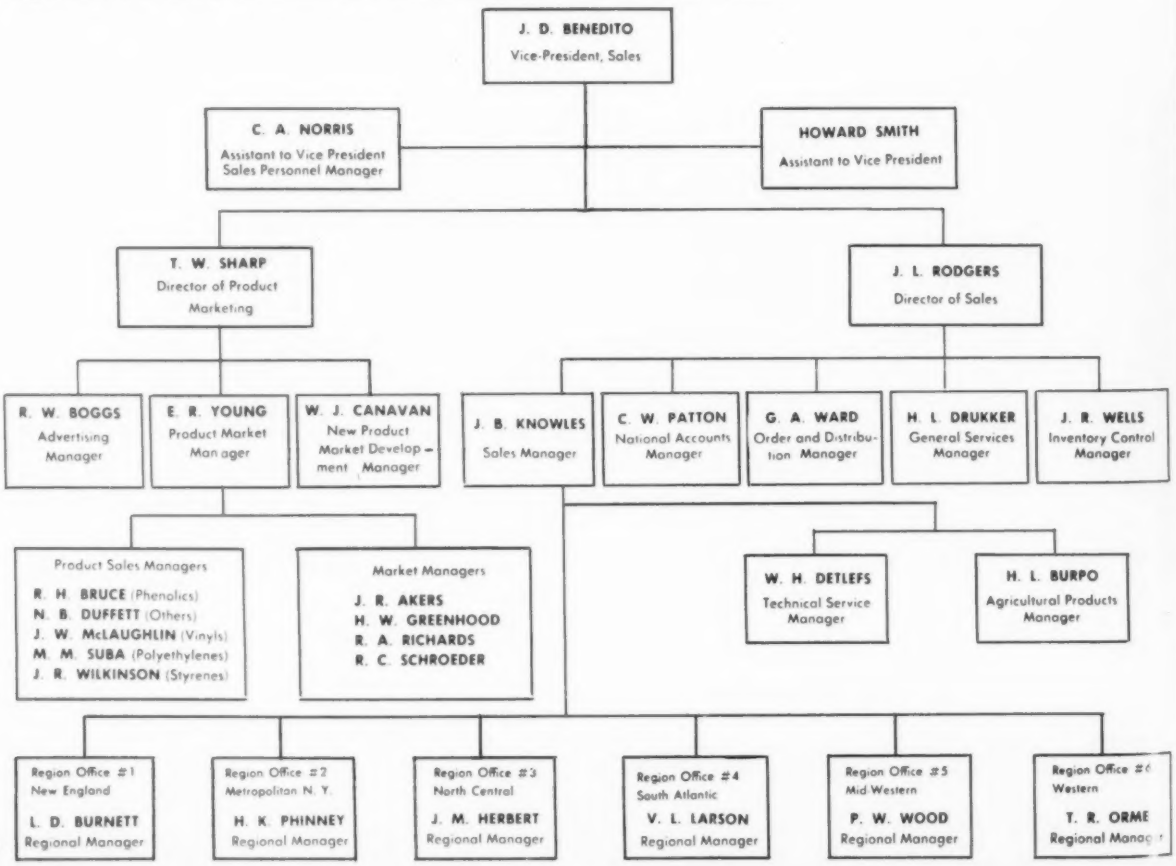
Plastics material producer companies have grown to tremendous size over the last 10 years to keep pace with the ever-increasing demand for their products. As a result, the close person-to-person contact between seller and buyer once so prevalent in the industry has been partially dissipated. Union Carbide expects to overcome this distant relationship by setting up a system that will combine big company service, such as research and technical help, with personal attention that will rival that of a small company president who knows his customers by their first name.

The key to this modern organization alignment is in the regional manager plan indicated in the bottom row on the chart accompanying this article. These regional managers are invested with more authority than is generally found in the time-honored district manager system now employed by most large corporations. Each will receive a constant flow of information from New York headquarters on such matters as inventory, policy, etc. Each regional manager will be responsible for the complete line of Union Carbide's plastics products. He will be able to give customers a quick "yes" or "no" on most problems which arise in the field without calling New York. If the question should require a response from N. Y. headquarters the regional manager will have an open channel that assures quick answers.

There will be little change in the salesmen who are calling on customers—each will continue to call on essentially the same customers as in the past and report directly to his regional manager. Each of them will continue to sell by fabrication process rather than material—thus one man sells

*Reg. U.S. Pat. Off.

Organizational chart of Union Carbide Plastics Co. new sales set-up



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calendering materials, another sells surface coating materials, and so on.

Each regional manager will report to sales manager J. B. Knowles, who in turn reports to director of sales J. L. Rodgers, who is also responsible for all the various activities, including inventory control and distribution, that are essential to a smooth-working sales organization.

T. W. Sharp

J. L. Rodgers

Mr. Knowles will manage activities of the six regional managers, a technical service manager and an agricultural product sales manager. He joined Bakelite in 1938, was made division manager of film and sheeting in 1952 and general sales manager of consumer products in 1956.

Mr. Rodgers, who will coordinate all direct sales activities, joined Bakelite in 1936, served with the National Production Authority during the Korean war and became general sales manager of the molding and extrusion division in 1956.

Another link tied directly to sales is the appointment of Carl W. Patton as manager of national accounts. His duties will be to coordinate sales activities with those customers having multi-plant operations distributed over the country. He joined the company in 1932, became manager of coating materials in 1952, and manager of advertising in 1954.

A highly interesting angle can be seen in the other half of the new alignment. This new section is called Product Marketing which is essentially a planning operation concerned with developing, maintaining, and expanding new and old markets. For example, one of the industry's present day problems that the section will concentrate on is the reduction of the lag between commercial production and capacity. The director of Product Marketing is T. W. Sharp. He joined Bakelite in 1933, became division manager of the Flexible Packaging Materials Division in 1954 and general sales manager of the Industrial Products Dept. in 1956. Reporting to Mr. Sharp will be the advertising manager, R. W. Boggs, formerly in the public relations dept. of the parent Union Carbide Corp., whose duties are obvious; E. R. Young the Product Market Mgr.; and W. J. Canavan, New Product Market Development Mgr. The last will supervise development of new products from a marketing point of view and turn them over to Sales when they are ready for commercial exploitation. Mr. Young will supervise sections headed by Product Sales Managers and Market Managers. Each of the five Product Sales Managers will be responsible for one material—phenolics, vinyls, etc. It will be his duty to see that the field salesmen have the right kind of material to meet the customers' needs—and to answer such questions as: what do we need that someone else has which is moving in on us?

C. W. Patton

J. B. Knowles

The Market Managers work in the field of materials. A typical question that one of them might be asked to solve is: what must we do to get a better share of a given market such as radio, refrigeration, etc. Their problems are roughly those of defining and promoting market possibilities. Problems of the Product Sales Managers are those of seeing that the right resins are available for those markets.

There is another group of managers, not listed on this chart, who were appointed about a year ago. They are called "Product General Managers." They too work with materials—each major resin is assigned a Product Manager. Their job is liaison between production, development, research, and sales, with particular emphasis on long range planning.

Coincidentally with the realignment of their selling and marketing organization Union Carbide announced that the former Bakelite Div. would hereafter be known as the Union Carbide Plastics Co. (see p. 39).

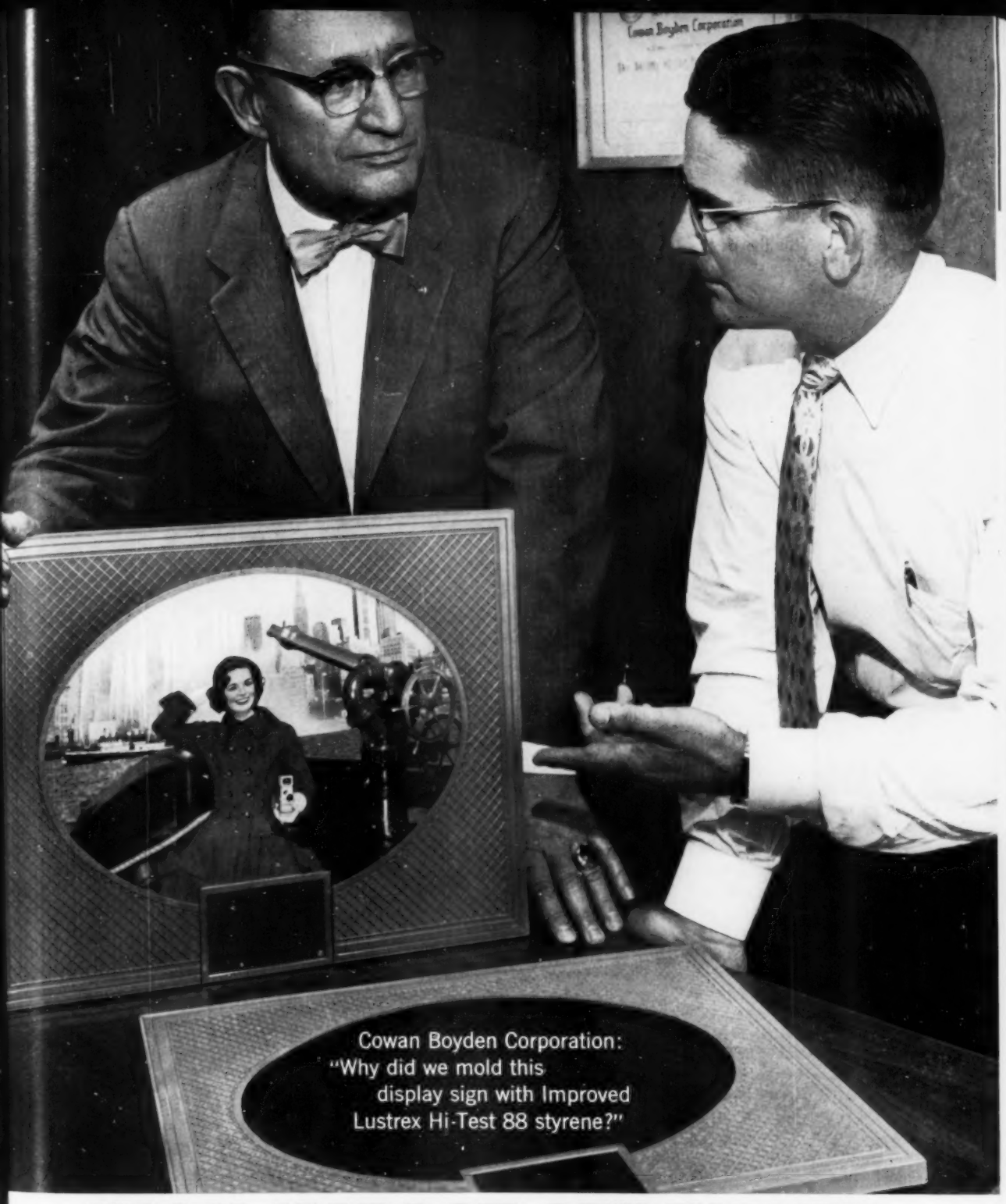
Plastics for Poland

Representatives from the Polish plastics industry recently visited this country with plans to spend up to $1 million on plastics raw material purchases. It is believed that only about half that amount was spent on resins—mainly polyolefins, fluorocarbons, and some specialty plastics—because U. S. prices for many resins were not competitive with those of other major producing countries, according to a Polish spokesman.

As in other Iron Curtain countries, the Polish plastics industry is under governmental economic control. Its stated objective is to equal U. S. per-capita-consumption of plastics. Since Poland does not have all the necessary raw materials to produce the large variety of plastics resins used in this country, an expansion of her plastics production may require increased imports from the major producing countries.

Polish authorities have stated that their country's plastics industry was 40 years behind the United States in 1950, is still 14 years behind at the present moment, but is expected to catch up within the next few years.

With research largely controlled by the government, the emphasis is on the development of materials required for the general industrial growth of the country. There is little "blue sky" research in Poland and not much interest in consumer products. However, the government does



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MR. CLIFFORD J. COWAN, *President*, and MR. J. J. CUSHING, *Production Superintendent* reporting: "This large display sign frame with molded-in hinges made this job critical from design through material selection. Our plant engineers perfected mechanical design and built the model. Improved Monsanto Lustrex Hi-Test 88 styrene was selected for the material because of its high impact, high gloss, moldability, as well as color uniformity. Finally, the excellent release quality of improved Lustrex Hi-Test 88 makes molding a continuous, smooth operation." *Write today for complete technical data on improved Lustrex Hi-Test 88 to Monsanto Chemical Co., Plastics Division. Rm. 224, Springfield 2, Mass.*

Monsanto

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not entirely prohibit the production of consumer items by private firms. It is reported for example that one man in Poland built an injection molding machine and made polyethylene shopping baskets which became a best seller. In general, however, the government decides which plastics products the country wants.

Foster Grant broadens activities

A new high-impact styrene molding material, Fosta Tuf-Flex 289, intended specifically for shoe heels, has been announced by Foster Grant Co., Inc., Leominster, Mass. The material is said to lend itself to new doweling techniques, and injection molding methods developed by the company. These methods are available to heel molders.

The company has also started developmental production of a nylon-6/6 film made from its own Fosta nylon. Resistance to oil and organic solvents even at elevated temperatures are particularly good properties of this nylon film. It can be heat-sealed when coated with oil or organic solvents.

First use of the film will be as a package for the company's sunglasses at nearly one-half the cost of previous packaging materials. Another suggested use is for rainwear since nylon film transmits water vapor, but resists penetration by liquid water. It may also find use as a packaging material for herbs, spices, coffee, etc., where retention of flavor and aroma are important, since its transmission of food odors is low.

At present the film is available in developmental quantities in thicknesses of from 1.5 to 20 mils, and in widths up to 36-in.

Polyethylene plate

Extruded polyethylene sheet in continuous lengths up to 48-in. wide and 1½ in. thick is available from Westinghouse Electric Corp.'s Micarta Div. The sheet is said to have a room temperature tensile strength of 1700 p.s.i. and a modulus of elasticity up to 19,000 p.s.i.

The sheet is intended for neutron shielding on nuclear reactors where weight and space limitations are a primary consideration. It can also be used for structural or semi-structural members in fume hoods and tank linings where chemical inertness, thick cross-section stiffness, and unlimited length can be used to advantage.

Cu. in. cost of ABS polymers

In the chart on p. 131 of our November issue, entitled "Cost per cubic inch of plastics and other industrial raw materials," a flagrant error was made. It had to do with the ABS polymers.

To set the record straight, the average price for ABS molding and extrusion pellets on a "cents per cubic inch" basis for the past several years is as follows:

1954-1955	$.0244/cu. in.
1955-1957	$.0226/cu. in.
1957-to date	$.0202/cu. in.

Readers will note these materials are lower in cost per cubic inch than many other plastics materials as well as zinc and aluminum.

High-density polyethylene pipe

A flexible polyethylene pipe which combines high resistance to stress-cracking with a chemical resistance and which has a life, said to be comparable to PVC pipes has been introduced by Carlon Products Corp., Cleveland, Ohio.

Designated Carlon Hi-Mol, the pipe is made from high-density A-C polyethylene, manufactured by Allied Chemical's Semet-Solvay Petrochemical Div. This new high-molecular weight, (over 1,000,000) high-density polyethylene is said to make possible pipe that withstands pressure surges, torque stresses, and high operating temperatures. According to Carlon, the pipes can handle high corrosive fluids at low pressures under operating temperatures as high as 150° F. On pressure surge tests of 300 p.s.i. at a rate of 10 per minute, the pipe is reported to have a life of 150 hr., compared to 11 min. for ordinary polyethylene, the company states.

The new pipe is available in 3- to 6-in. diameters, in folded continuous lengths up to 500 lb. total weight. A 4-in. pipe, for example, could be obtained in approximately 400 ft. lengths. The pipe is easily unfolded by applying steam to the bends with no appreciable loss in tensile strength. Coils in sizes ½- through 2-in. are also available, as well as 30 ft. lengths in 3-, 4-, 6-, and 8-in. sizes.

In addition to industrial applications for handling corrosive fluids at low pressures, the manufacturer expects to find a market for the new pipe in wells, farm watering, skating rinks, etc.

Heat sealing equipment company acquired

Willcox & Gibbs Sewing Machine Co. has acquired the Thermatron Div. from Radio Receptor Co., a subsidiary of General Instrument Corp.

The operation will be known as The Thermatron Co., Industrial Electronics Div., of Willcox & Gibbs Sewing Machine Co. The present staff of Thermatron will continue to operate the company, with Ivan H. Schwartz as general manager, and Milton Rothstein as director of engineering and development.

Thermatron makes a line of equipment for dielectric welding and sealing; for curing plastisols and resin adhesives; and similar machinery for the plastics, packaging and other industries.

Polypropylene welded joints

Potential users of fabricated polypropylene can obtain a free test kit to evaluate the material before it is fabricated from American Agile Corp., P. O. Box 168, Bedford, Ohio.

The company will supply a welded section made from its Agile-Prolene inside a test tube under highly stressed conditions, said to be more severe than any encountered in service. This spe-

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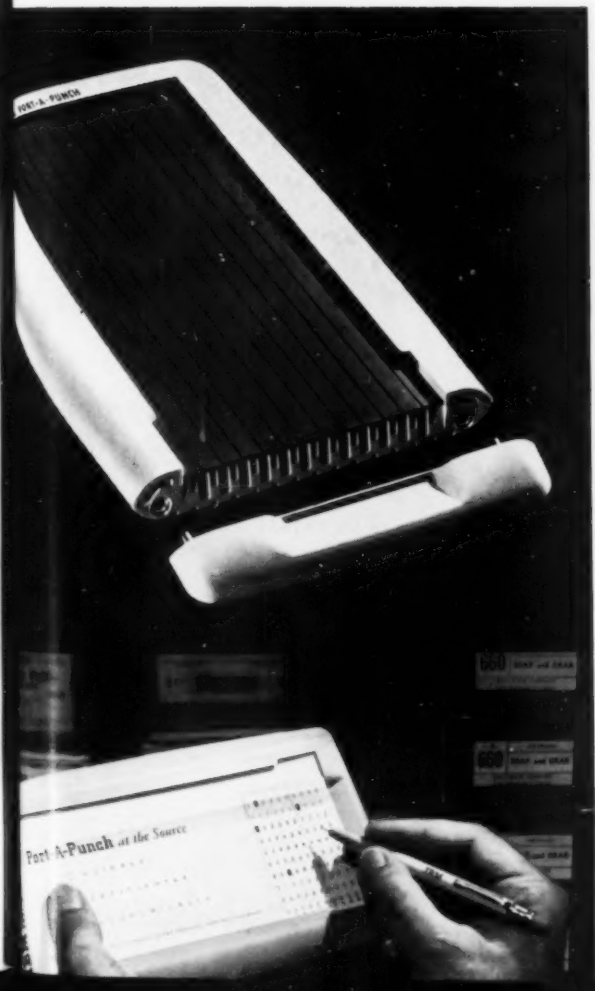

VERSATILE STYRON 440M FOR FASTER INVENTORIES. This unique inventory report system saves steps by allowing part numbers and quantities to be recorded directly into data processing punched cards at the point of inventory. The "high-fidelity" in the mold of Styron® 440M made possible the intricate, accurate design of the housing interior. Its resistance to impact and wear makes it ideal for rough-and-tumble service in plants and warehouses.

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cimen can then be covered with the specific solution which it is intended to handle, at the expected processing temperature.

Agile claims that the material will withstand nearly every stress cracking agent. More than 4000 hr. of testing in the company's laboratories determined that only sulphuric acid will destroy a welded polypropylene fabricated section, Agile reports.

Nylon aerosols

Among the first commercial nylon aerosol containers for a consumer product is a molded, teardrop shaped bottle for Tilford's "Stay Put" hair spray. Besides being decorative, the container is exceptionally strong, and will not shatter, even if dropped on a tile or concrete floor, according to Du Pont who supplies the Zytel nylon resin for this product. The container is translucent permitting visual determination of contents level.

Among the companies producing nylon aerosols is National Plastic Products Co., Odenton, Md. (See also "Glamor for aerosols," MPL, August 1957, p. 86.)

Consulting service

Plans to broaden the scope of the company's activities to a world wide basis have been formulated by Roger Williams Technical & Economic Services, Princeton, N. J. A branch office recently set up in Havana, Cuba, constitutes the beginning of a program to increase the first hand knowledge of the company's personnel of foreign countries, especially in Latin America, which is expected to become an ever-increasing market for American plastics products.

Williams handles various types of chemical market research but specializes in plastics. Among the subjects covered in market research projects have been polyethylene, reinforced plastics, dibasic acids, specialty plastics, foaming agents for plastics, furfural, isocyanate foams, plastic pipe, vinyl acetate, vinyl alcohol and many others.

Plastics plant closes

American Motors Corp. has closed its plastics plant at Milwaukee, Wis., and transferred operations to an AMC subsidiary at Evart, Mich.

William P. Gobeille, manager of the plastics division, stated that about 115 employees are affected. Job possibilities are being explored at other AMC facilities. Some supervisory employees are being transferred to the Michigan operation.

The plastics division makes automotive and refrigerator parts, both for American Motors and for other companies. The plant was set up in 1947.

Protects missile nose cones

A high-heat-resistant plastic-and-fiber electrical grade material, designated Duroid and developed by Rogers Corp.. Rogers, Conn., is being used in the Jupiter IRBM for antenna inserts.

According to the company, performance of the material is not significantly affected by exposure to extreme temperatures encountered when the nose cone reenters the atmosphere.

Expansion

Inta-Roto Machine Co., Inc. has completed a 7200-sq. ft. building at Richmond, Va. for the assembly of rotogravure and flexographic presses, and laminating machines. The company also manufactures slitters, rewinders, and other special machines for film, foil, paper and paperboard.

Plastic Applicators, Inc., Div. of Rubber Applicators, Inc., has installed injection, compression, and transfer molding equipment at its 5-acre manufacturing site in Houston, Texas. Milling, compounding, and calendering capacity for sheeting and mold stock requirements is also available. The company supplies molded plastics and rubber items, including seals, O-rings, gaskets, expansion joints, etc., and molded electrical components.

Fiber Industries, Inc., the jointly owned company recently formed by **Celanese Corp. of America** and **Imperial Chemical Industries, Ltd.** of Great Britain, selected a 215-acre tract near Shelby, N. C., as the site for its new plant for the production of Teron polyester fiber. It is expected that construction work on the first unit of the plant will begin by January, 1959.

Executive offices of the company will be located in Charlotte, N. C.

Tube-Kote, Inc., plastics coating applicator, has dedicated a new research laboratory in Houston, Texas. The new facility houses quality control, production control, research sections, and the company's coating evaluation activities.

Equipment of the new research laboratory includes a high pressure device that can test coatings in various corrosive environments with pressures up to 15,000 p.s.i., and temperatures up to 500° F.

Bel-Art Products, 4917 Murphy Place, West New York, N. J., manufacturer and fabricator of plastic laboratory ware and allied products, has completed its new plant at Pequannock, N. J. This expansion increases its production, stocking, and shipping facilities three-fold. The company processes polyethylene, polypropylene, Teflon, nylon, acetate, and vinyl.

Reichhold Chemicals, Inc. is constructing a $5 million plant capable of producing 30 million lb. of phthalic anhydride annually at Elizabeth, N. J. It will be designed for quick expansion to an annual output of 50 million pounds.

Construction of a $1 million plant in Houston, Texas, for the production of synthetic resins, including alkyds, polyesters, and emulsions, has also been announced. This new RCI facility, scheduled for completion by mid-

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1959, will be under the managership of **Don Leever,** currently the company's division director of technical service at Kansas City, Kan.

Escambia Chemical Corp. has dedicated a 50,000 sq. ft. research laboratory at Wilton, Conn. Some 50 persons will be employed immediately with ultimate personnel of about 100 envisioned. The facility will be devoted to research in materials for the plastics industry, synthetic organic chemicals, and pharmaceuticals.

Commercial Solvents Corp., New York, N. Y., has opened bulk storage facilities for 2-Nitropropane at Newark, N. J., and Los Angeles, Calif. This product is used as a solvent for polymeric materials such as epoxy, vinyl, and acrylic resins, cellulose acetate, and cellulose acetate butyrate, and will be available at Newark in tank cars, tank trucks, and in combination tank trucks at 16¢/lb. delivered.

Lupoline Automatic Polishing Equipment Corp., Tuckahoe, N. Y., plans to establish a laboratory and manufacturing plant in London, England, to produce semi- and fully-automatic tumbling machines for the plastics industry.

U. B. S. Chemical Corp., Cambridge, Mass., manufacturer of polymer chemical products, plans to construct manufacturing facilities for some of its newer products at the Industrial Center, Marlborough, Mass.

Farrel-Birmingham Co., Inc., Ansonia, Conn., supplier of heavy-duty equipment to the plastics and rubber industries, has purchased **Electrophysical Engineering Co., Div. of National Automotive Fibres, Inc.,** Orange, Calif., extruder manufacturer.

R. H. Wenzel, inventor of the Inductomatic element used in EPE extrusion machines, joins the extruder div. of Farrel. Sales and service of EPE equipment on the West Coast will continue under **Leonard Rose.** Manufacturing will be carried on in the present plant at Orange, Calif., and also in the Farrel-Birmingham plant in Rochester, N. Y., where the **Watson-Stillman Press,** and **Consolidated Machine Tool Divisions** are located.

The Kendall Co., Chicago, Ill., has dedicated its new Polyken polyethylene tape plant at Franklin, Ky.

Hurlbut Paper Co. has started up its new paper mill near the company's main mill in South Lee, Mass. Capacity of the new facility is rated at 50 tons per day, and the $5 million project represents a 125% capacity growth for the company. Hurlbut, which became a subsidiary of **The Meade Corp.** earlier this year, manufactures resin saturating papers for decorative and industrial laminates, and other industrial papers.

Fluorocarbons

New monomer. The commercial availability of a new, unsaturated perfluoro compound, Perfluorobutene-2, has been announced by Halocarbon Products Corp., 82 Burlews Court, Hackensack, N. J. This compound is said to copolymerize readily with other monomers, and is being studied as a modifier in the development of special polymers.

Perfluorobutene-2 undergoes reactions common to fluoro olefins, including halogenation and the formation of beta-H-perfluoroalkyl ethers.

Coating process. A process whereby Teflon resin is electrodeposited upon metallic and non-metallic parts and subsequently fused, has been announced by Redel, Inc., 220 N. Atchison St., Anaheim, Calif. According to the company, this process produces a corrosion-resistant coating with improved adhesion, less porosity, and better control of thickness than with conventional dispersion coating applications.

Valve stems and bodies, coil forms and other electronic components, and a variety of other parts are regularly processed by Redel on a custom basis at a price not much higher than conventional electroplating, the company states.

Large-diameter moldings. Full-scale commercial production of molded Teflon rods and tubes up to 15-in. O.D. has been announced by Chemplast, Inc., 3 Central Ave., East Newark, N. J. Lengths of rods and tubes are offered up to 12 in. for sizes of 6-in. O.D. and lower, with 6-in. lengths for larger sizes.

According to the company, special molding techniques permit the production of massive moldings that are free from cracks and fissures.

Increases line. A new line of Fluorolin tapes in a wide range of colors, thicknesses, widths, and lengths has been introduced by Joclin Mfg. Co., Wallingford, Conn. The tapes, made of virgin Teflon, are coated with pressure-sensitive adhesive and include skived, extruded unsintered, extruded sintered, and cast films.

Colloidal dispersions. Dispersions of Teflon resins in a selection of binders with characteristics enabling application of TFE to heat-sensitive surfaces have been developed by Acheson Colloids Co., div. of Acheson Industries, Inc., Port Huron, Mich.

Designated Emralon, the dispersions can be cured at about 300° F. This compares to a sintering temperature for Teflon of about 700° F. Thus, the new development makes possible the application of Teflon to materials that cannot withstand the high sintering temperatures, such as thermoplastics, wood, rubber, etc.

Two types are currently available—Emralon 310 and Emralon 320. The former is a dispersion of Teflon in a phenolic binder. Applied by spray and oven cured,

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the dispersion exhibits the low-friction properties of TFE with the durability of the binder, the company states. Emralon 320 is air-drying and designed for use on substrates that cannot withstand baking temperatures.

Application is by spray gun. Coatings thicker than the 0.6 mil can be made by multiple passes. Properly applied the film is smooth and continuous, the company states.

Industrial uses include coatings for molds, drums, extrusion dies, gaskets, conveyors, pumps, slides, and engine parts. Home applications include window casings, drawer guides, casters, door hinges, etc.

Acheson is offering introductory packages of either Emralon 310 or 320 at $4.25 postpaid ($4.50 west of the Rockies). Each package contains enough material to coat 5000 sq. in. of surface.

Reinforced plastics

Silicone laminate. A coarse weave continuous filament glass fabric bonded with a silicone laminating resin has been developed by Continental-Diamond Fibre Corp., Newark, Del., subsidiary of The Budd Co.

Designated Dilecto GB-89S, it is said to combine high resistance to flame, heat, arc, and moisture, with good electrical and mechanical properties. It is available in sheets, or molded shapes such as "U" channels, and is intended for terminal, mounting, and spacer blocks; switchgear; electric welders; and similar applications, involving arcing and localized or ambient temperatures up to 200° C.

Synthetic fiber mats. A line of AllFab acrylic fiber reinforcements, chemically bound into felts or mats, is now available from The Felters Co., 210 South St., Boston, Mass. The synthetic fibers are claimed to possess improved outdoor weathering qualities, better electrical insulating properties, higher resistance to abrasion and the action of various chemicals, and lower weight than other fiber reinforcements. The thermoplastic binder used permits maximum draw and elongation without tearing in deep draw applications. It is reported that its heat distortion is more than adequate to meet manufacturing requirements and that it does not interfere with resin-to-fiber adhesion.

Barrier cream. Protection against fine microscopic glass particles which irritate workers' skin in fibrous glass factories is claimed for Kerodex, a barrier cream produced by Ayerst Laboratories, 22 E. 40th St., New York 16, N. Y. The cream has a "lifting" action when wetted, and rinsing the hands in water brings up, and washes away, fibrous glass particles, the company claims.

According to Ayerst, the cream can be applied with equal safety to the face, hands, or any other skin area.

Improved coated panels. Structural fibrous glass-reinforced panels are now being produced by Resolite Corp., Zelienople, Pa., with a special coating that is said to increase the panels' weatherability, resistance to erosion, and color stability by several additional years.

Called Super-Hardcoat, the coating is a specially formulated clear, acrylic lacquer of extreme hardness and impermeability which is reported to resist airborne dust erosion, and to seal the polyester resin surface against deterioration and blushing of the glass fiber.

The product is currently being used in the production of Resolite Fire-Snuf, a fire-retardant panel. According to the company, the process does not increase the flame-spread rating of these panels, which is listed under 75. The new process, reported to have been tested and accepted by Underwriters' Laboratories, can be applied to any of the standard Resolite products, as well as to Fire-Snuf.

Deceased

Russell M. Fellows, 66, chairman of the board of directors, and treasurer of **The Fellows Gear Shaper Co.,** Springfield, Vt., died on Oct. 13. He started work with the company in 1911, was elected vice-president in 1945, and became chairman earlier this year.

Meetings

Plastics groups

January 7, 1959: Society of Plastics Engineers, Inc., Western New England Section, Bradley Field, Terrace Dining Room, Windsor Locks, Conn. Subjects: "Polystyrene in Lighting," "Mold Polishing."

January 27-30: Society of Plastics Engineers, Inc., Newark and New York Sections, 15th Annual Technical Conference, Hotel Commodore, New York, N. Y.

January 27: General Electric Co., Plastics Alumni, Dinner Meeting, Hotel Commodore, New York, N. Y.

February 3-5: The Society of the Plastics Industry, Inc., 14th S.P.I. Reinforced Plastics Div. Conference, Edgewater Beach Hotel, Chicago, Ill.

Other meetings

January 4-9, 1959: The China, Glass & Pottery Association of America, Inc., Atlantic City China & Glass Show, Convention Hall, Atlantic City, N. J.

January 9: University of Akron, Akron Polymer Lecture Group, Room 107, Knight Hall, University of Akron, Akron, Ohio. Subject: "Chain Configuration and Elasticity."

January 12-16: National Housewares Manufacturers Association, 30th NHMA National Housewares Exhibit, Navy Pier and Drill Hall, Chicago, Ill.

January 18-22: National Association of Home Builders of the U. S., 15th Annual Convention & Exposition, Chicago, Ill.—END

U.S.I. POLYETHYLENE NEWS

A series for plastics and packaging executives by the makers of PETROTHENE® polyethylene resins

Packaging Notes

olorful striped polyethylene film makes ossible unique package creations. Prouced from U.S.I. PETROTHENE resins by midwest extruder, the film is competiive with printed striped film in price. nlike printed film, the film with exruded stripes looks equally attractive n both sides. The color will not rub or ear off.

olyethylene film — with extruded-in stripes at won't rub or wear off — is equally attracve on either side and can be obtained in a ised or embossed effect to provide a rich feel.

The film is produced generally as a lear film with stripes of any single olor. It is also possible to produce two ifferent color stripes, or to construct a ie to produce alternating stripes on a lear background, or even to obtain a hree color effect. Translucency or ransparency of the colors can be varied s desired. A raised or embossed effect s also possible. The film is made with tandard extruders which have been odified considerably to make possible he fusing of two or three different color treams within the die.

The film is produced as tubing in production thicknesses ranging from 1.25 o 10 mils. It is expected to be used for novelty packaging of candy, cosmetics, tationery, some soft goods, toys, cotton alls and other drug items, and certain oods.

Transfer labeling of poly squeeze bottles s being done at savings of 75% in printng costs by means of a new direct hermal transfer method. The transfer abels are printed on a kraft paper carrier. Heat and pressure applied by a pecial machine transfers the legend to he squeeze bottle.

The method is said to combine the attractiveness and durability of preprintng with the versatility and economy of abeling. The transfer unit can be mounted on any standard wrapping, undling or bagmaking machine.

New machine forms and heat-seals polyethylene-coated blanks to produce carons and trays which are highly reistant to grease and moisture without he need for liners. The machine operates at speeds up to 180 or more units per minute. It is designed for packaging ookies, crackers, fig bars, confections, rozen foods, cosmetics, cigarettes, vegetables and other products.

Comprehensive Guide to Polyethylene Processing Completed by U.S.I.; Copies Now Available

100-Page Guide Covers Molding, Extrusion and other Problems

U.S.I. has just released a useful, comprehensive booklet on polyethylene processing. The 100-page booklet "PETROTHENE® Polyethylene . . . A Processing Guide"—is based to a large extent on research carried out by U.S.I.'s scientific staff and on experience gathered by its technical service engineers.

Abundantly illustrated, the booklet stresses practical shop information throughout, with only as much basic scientific theory as is needed to make the practical material readily understandable. The booklet discusses polyethylene properties, routine quality control tests and the various techniques for processing polyethylene—film and profile extrusion, extrusion-coating of paper and other substrates, wire and cable coating, injection molding, bottle blowing, thermoforming and others, along with related subjects such as heat sealing and film printing.

The booklet is filled with pages of invaluable shop advice for all types of processors. Many paragraphs are devoted to such specific problems as the causes and prevention of wrinkles in blown film, factors affecting the quality and economics of heat sealing, the machine conditions and resin properties which result in minimum "neck-in" and beading in paper coating and the effect of resin type and mold characteristics on cycle time or warpage.

"PETROTHENE® Polyethylene . . . A Processing Guide" is now available free to processors and convertors. For your copy, write to Editor, U.S.I. Polyethylene News, U. S. Industrial Chemicals Co., 99 Park Ave., New York 16, N. Y.

Poly-Coated Corrugated Board Now in Commercial Production

Poly-coated corrugated board is now available for the first time. The problem of high temperatures on the corrugator has been avoided by extrusion-coating the liner board at the mill level and using a cold adhesive for corrugating.

Photo courtesy Mead Board Sales Co.

Corrugating line on which polyethylene-coated corrugated board is now being produced.

Among the applications for corrugated poly-coated containers are:

Bulk shipment of meat, where moisture and grease-proof interiors reduce weight loss of the meat and eliminate loss of container strength through moisture pickup;

Shipment of furniture and other hard goods, where abrasion damage from the container has been a problem;

Bulk bakery and confectionary shipments, where absence of greasewickage makes containers suitable for reuse or use as point-of-sale displays;

And in concrete construction forms, with the poly coating acting as a release agent.

Tests Show Many Aromatics Can Be Packaged In Poly

A two-year study has shown that a large class of essential oils can be packaged in polyethylene containers with little or no permeability loss.

The tests showed that oils of high viscosity and low terpene content experienced little or no weight loss.

In this group were such aromatics as Oil Bois de Rose; Oil Cassia Rectified; Oil Citronella Java; Oil Coconut Edible, N. F.; Oil Geranium Algerian; Oil Lignaloe Wood, Mexican; Oil Vertivert Bourbon; Oil Patchouly Penang; Oil Sesame U.S.P.; Oil Ylang Ylang; and Oil Almond Sweet expressed U.S.P.

From these, fragrance compounds have been developed for use in polypackaged anti-perspirants, creams, lotions, and shampoos.

Cleveland OK's Plastic Pipe

The city of Cleveland has amended its building code to permit the use of plastic pipe for street-to-house water service lines. The decision was made after plastic pipe easily passed rigorous pressure, temperature and torsion tests.

Plastic pipe is considered ideal for street-to-house water lines, which do not involve high pressure or extreme temperatures. It costs half as much as copper tubing and costs less to install.

Air Flow Problems?

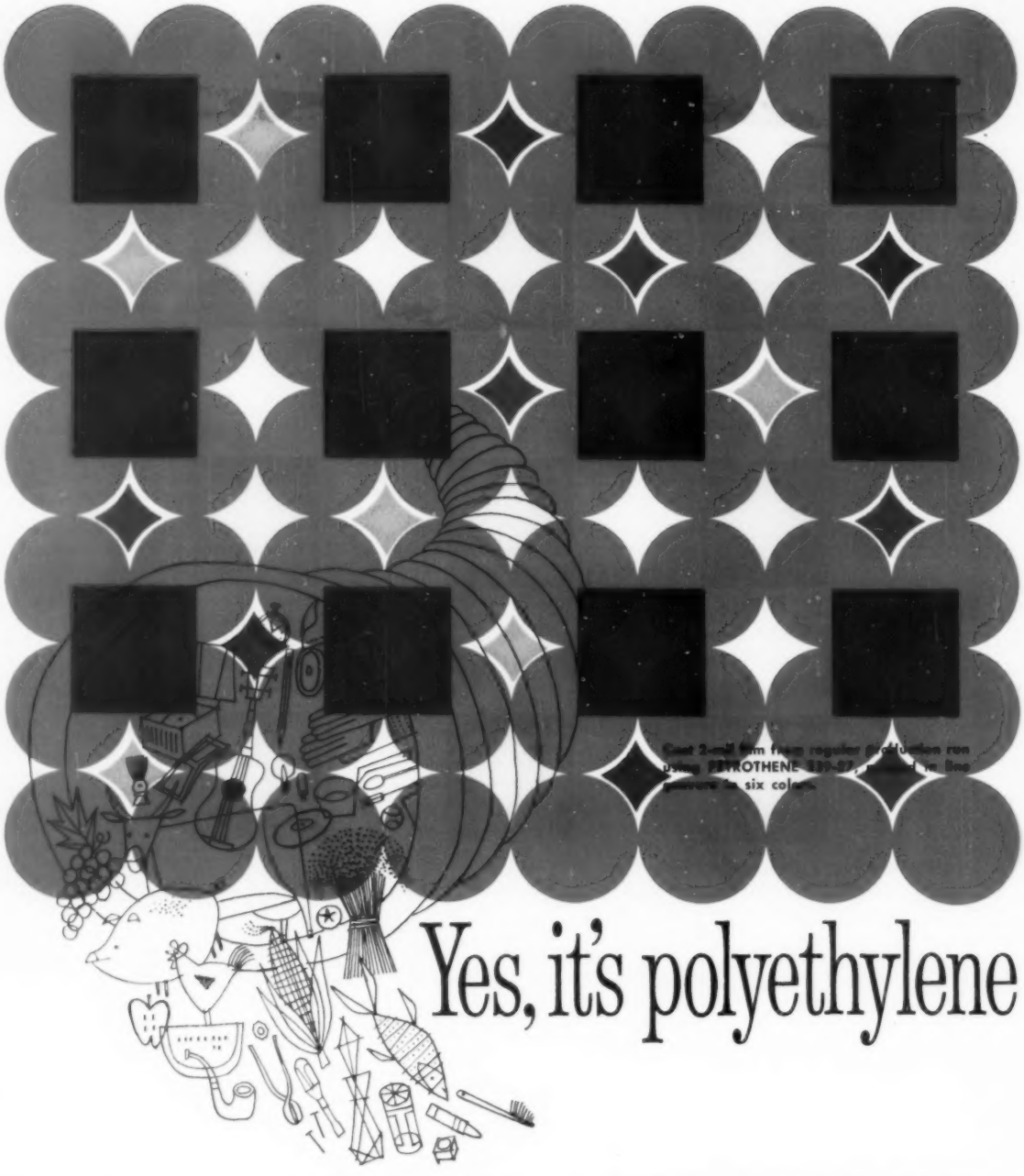
U.S.I. Technical Service has a portable air velometer capable of measuring up to 10,000 feet per minute. If you have a problem involving air flow, indicate this with your request for technical service so the U.S.I. engineer can have the instrument available when he calls.

IN THIS ISSUE:

P. 2 Printed PETROTHENE Film

P. 3 Treating Polyethylene for Printing

P. 4 How to Increase Your Market for Molded Polyethylene Products



Yes, it's polyethylene

When you add brilliant printability to the clarity, toughness, and other well-known advantages of polyethylene, you can offer your customers a packaging material that will work as a powerful merchandising tool for their products. Polyethylene film can be economically printed with clear, bright colors at high speeds and with sharp registration and good ink adhesion. Packages can be formed on automatic machinery — sealed by heat-sealing or with adhesives.

Opens New Packaging Film Markets

With package designs that combine sparkling, multi-colored printing with polyethylene film's clarity, you can open up new packaging and merchandising opportunities for your customers. Printed film is now being used for dry-cleaner garment bags, produce packaging, soft goods overwrap, dairy and meat packaging, laundered shirt packaging, and many other applications where visibility, eye-catching color, and protection can be combined in a single package to give maximum sales appeal to the product.

In supplying film for this growing market, keep in mind the special advantages of U.S.I. PETROTHENE® polyethylene resins: excellent drawdown properties . . . superior toughness/clarity ratio in finished film . . . wide selection of resins ideally suited for clear or printed packaging film. Contact your nearest U.S.I. sales office for information.

U.S.I. is helping to expand your polyethylene film market with ads, similar to this one, addressed to the produce, food, dry-cleaning, and other package-using industries. These ads are designed to pre-sell your potential customers on the sales appeal and other advantages of polyethylene film packaging. To receive reprints of this advertising as it appears, write:

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N.Y.
Branches in principal cities

U.S.I.

Vol. III, No. 6

POLYETHYLENE PROCESSING TIPS

PRINTING ON POLYETHYLENE FILM: HOW TO SURFACE-TREAT FOR GOOD INK ADHESION

Because printing inks adhere poorly to untreated polyethylene film, it has been necessary to develop surface-treating techniques in order to print satisfactorily on this important packaging material. These techniques fall into two general categories – chemical treatment and physical treatment. Both have the effect of polarizing the surface of the film, making it receptive to ink which then becomes bonded to the film and cannot be removed by rubbing.

Chemical treatments which have been developed and tested to date are more costly and difficult than are physical treatments recently perfected. Consequently, this discussion will be devoted to physical means of treating polyethylene film; equipment and techniques developed to achieve the best possible results; and the problems which may be encountered by the processor during treatment.

Flame And Electronic Treaters

There are two physical methods of preparing polyethylene surfaces for printing – flame and electronic treatment. While flame treatment gives excellent results, it is not as easily adapted to in-line operation, and thus is employed less in commercial practice.

Electronic equipment is used most commonly by the processor. It is relatively inexpensive, is easily adapted to in-line procedures, and is capable of giving satisfactory treat at roll speeds up to 300 ft./min. The degree of treat is a function of throughput rate and of intensity of treatment.

Most electronic treaters convert 115 volt, 60 cycle power into much higher frequencies and voltages to produce a high electrical potential across the film. The discharge of this electrical potential effects desired treatment and makes the polyethylene surface receptive to decorative matter.

Problems In Electronic Treating

Equipment, film, resin – all represent problems for the processor during surface treatment. Electronic treaters increase the static charge on the polyethylene film surface which must be bled off by a combination of brush and transformer type static eliminators. Such treaters also give off ozone during operation, so that adequate ventilation must be provided around the equipment.

It has been found that the presence of additives in the film interferes with surface treatment. Slip additives, lube oils, antistatic agents, antioxidants and antiblock agents all present problems. It seems that most of these materials tend to "bloom" or come up to the surface where they hinder treatment.

Consequently, films with high additive contents must be treated under more drastic conditions or at slower speeds. Ideally, they should be treated in-line as close to the blown film die as possible and printed immediately thereafter.

The type of polyethylene resin used is also a factor. Low-density resins treat more easily than higher density resins.

Tests For Degree Of Treat

Several methods have been devised for determining whether the film is being adequately treated for printing. Of these, the Scotch Tape test is most commonly employed as a quick test for control purposes. Here the treated film is printed using a standard ink and tape is applied to the print after drying. The tape is then drawn back slowly over about half its length and rapidly pulled off the remaining area. Treat is satisfactory if no ink is removed from the film.

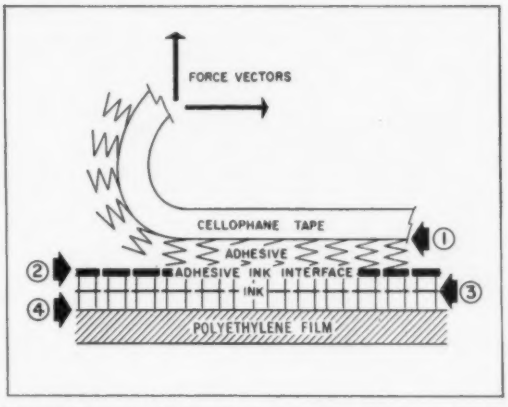


Diagram illustrates the four bond ruptures possible in the Scotch Tape test: (1) tape-adhesive rupture; (2) adhesive-ink rupture; (3) ink-ink rupture; (4) ink-polyethylene rupture.

U.S.I. Will Advise

The many factors involved in treating polyethylene surfaces for printing require careful consideration. As a manufacturer of polyethylene resins, U.S.I. has studied many phases of the subject and is equipped to help the processor find adequate solutions to his problems.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp
99 Park Ave., New York 16, N.Y.
Branches in principal cities

Cast 2-mil film from regular production run using **PETROTHENE 239-27**, printed in line gravure in six colors.

Yes, it's polyethylene

When you add brilliant printability to the clarity, toughness, and other well-known advantages of polyethylene, you can offer your customers a packaging material that will work as a powerful merchandising tool for their products. Polyethylene film can be economically printed with clear, bright colors at high speeds and with sharp registration and good ink adhesion. Packages can be formed on automatic machinery — sealed by heat-sealing or with adhesives.

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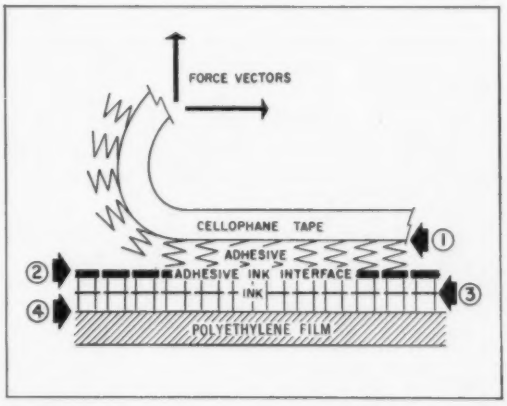

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U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp
99 Park Ave., New York 16, N.Y.
Branches in principal cities

HOW TO INCREASE YOUR MARKET FOR MOLDED POLYETHYLENE PRODUCTS...

We all know what a good plastic material we've got in polyethylene. It's durable, attractive and economical. But remember—the sales appeal of molded polyethylene products is based on SERVICEABILITY. In the long run, the size and growth of your molded polyethylene market depend on how well you build quality into your products. It's not an easy job. Here are a few typical problems that molders encounter frequently, and some of the suggestions that U.S.I. technical service people have come up with:

LOW TEMPERATURE FLEXIBILITY

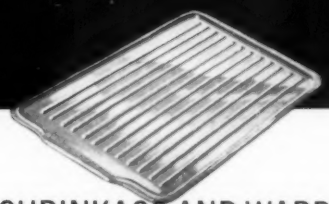
Understandably, there's little market future for polyethylene garbage cans that shatter on a cold winter's morning. The secret of getting good low temperature flexibility lies in proper resin choice. Look for resins with low density. As far as melt index is concerned, the lower the better for low temperature flexibility—providing the resin can be molded without going to pressures that will cause locked-in stresses. Avoid unrelieved stresses caused by poor design or molding techniques. And use-test your finished product—theoretical resin brittleness values may not mean much under practical conditions.

Recommended PETROTHENE® resins: 202, 203, 206, 207.

STRESS CRACK RESISTANCE

Why will a polyethylene carboy safely carry sulfuric or hydrofluoric acid, while a housewife's dishpan may split from the chemical effects of ordinary household detergent? The answer again involves stress and choice of resin. Specifically, resins of higher molecular weight or lower melt index, and polyethylenes of narrow molecular weight distribution, such as Petrothene resins, have less tendency to crack under environmental stress. Residual strains left after molding will also have a marked effect on stress crack resistance.

Recommended PETROTHENE® resins: (for housewares): 200, 203, 205, 207.



SHRINKAGE AND WARP RESISTANCE

Molded products are moving into new markets where dimensional accuracy and stability are essential. Warpage in flat items, such as drainboards and large covers, is chiefly affected by molding conditions. However, resins of lower density and lower average molecular weight will have slightly less tendency to warp. Shrinkage, too, is a result of molding conditions, especially temperatures, but here again resins of lower density are less subject to shrinkage.

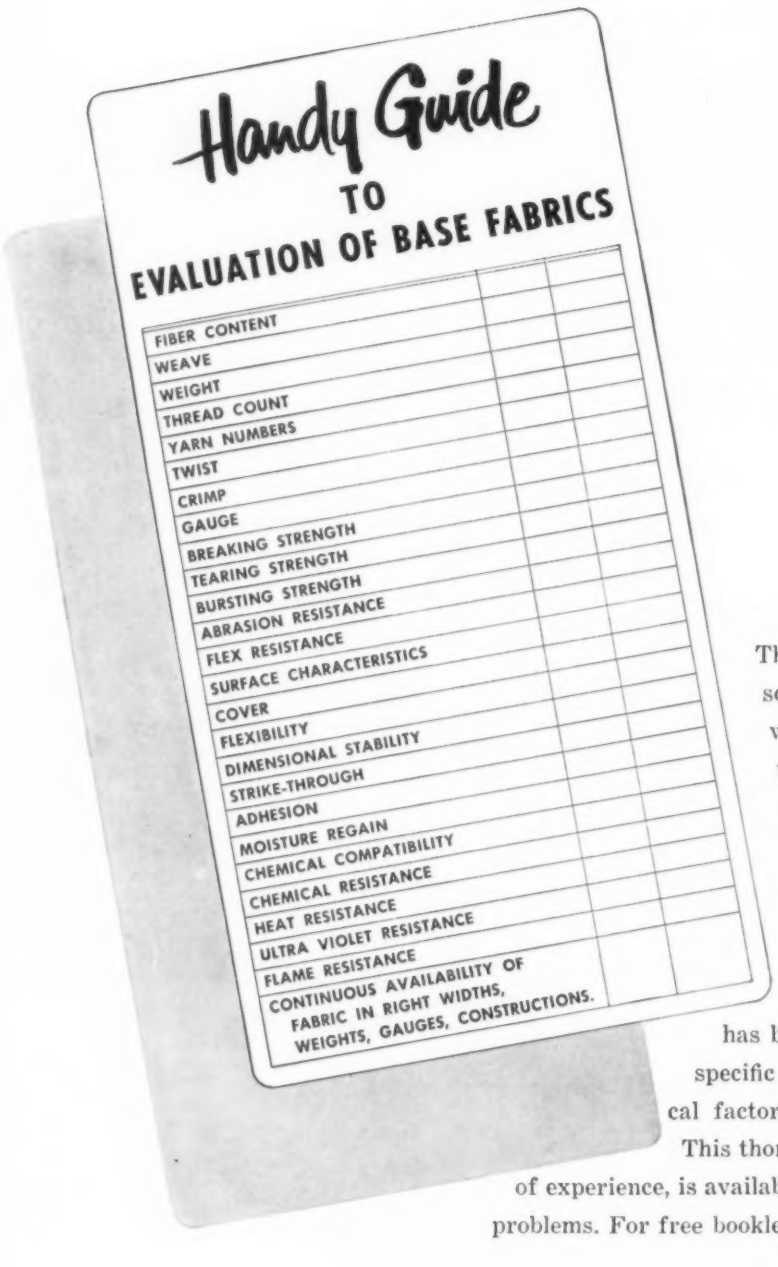
Recommended PETROTHENE® resins: 201, 202, 203.

For advice on specific molding problems and resin selection, contact U.S.I. Technical Service.

HERE'S HOW U.S.I. HELPS YOU TELL YOUR CUSTOMERS ABOUT THE MARKET ADVANTAGES OF QUALITY IN POLYETHYLENE PRODUCTS

In a series of ads like the one at left and in an illustrated booklet, "The Goose that Laid the Golden Egg," U.S.I. is presenting to buyers of housewares and other molded polyethylene products the reasons why quality is their best market booster. The ads and booklet emphasize the importance of well designed, well molded, serviceable products in maintaining consumer confidence in polyethylene. The program is designed to help tell your customers the advantages of dealing with you, the quality molder. Reprints of these ads and copies of the booklet for you to send to your customers may be obtained by writing to U.S.I.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corporation
99 Park Avenue, New York 16, N. Y.
Branches in principal cities



This fictitious "guide" has been created solely to show some of the factors which often have to be considered in the selection of a base fabric. They serve only to point up one fact: that there can be *no* such thing as a put-it-in-your-pocket guide in this field. But one thing is certain: when you're guided by Wellington Sears, you know that your base fabric has been considered in the light of your specific need, and that all significant technical factors have been thoroughly examined. This thoroughness, plus more than a century of experience, is available to help solve *your* working-fabric problems. For free booklet, "Fabrics Plus," write Dept. K-12.

WELLINGTON SEARS

FIRST In Fabrics For Industry

For Coated Materials, High and Low Pressure Laminates and Other Reinforced Products

WELLINGTON SEARS COMPANY, 111 West 40th St., New York 18, N. Y. • Atlanta • Boston Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis

Companies . . . People

Union Carbide Corp.—Union Carbide Plastics Co.: Dr. Howard L. Bender, sr. research associate, and with **Bakelite** (now U. S. Plastics Co.) since 1923, retired. He received the 12th annual John Wesley Hyatt Award in 1953, "for achievement of wide importance to the plastics industry," as a tribute to his lifetime of research and development in the field of phenolic resin molecular structures.

C. N. Kracht

Visking Co.: Clyde N. Kracht, formerly head of market research of the Plastics Div., named mgr.—market research for the company.

Union Carbide Chemicals Co. moved its Atlanta, Ga., dist. office to 1371 Peachtree St., N. E., and its Buffalo, N. Y., office to 4446 Main St.

United States Rubber Co., Naugatuck Chemical Div.: Thomas D. Ramsey appointed dist. sales mgr. in Gastonia, N. C.

John H. Woelflein named tech. sales rep. for Vibrin polyester resins in the Boston, Mass., and New York, N. Y., areas. **Lawrence A. King** appointed Vibrin plastic tech. rep. in the Los Angeles, Calif., area.

Allied Chemical Corp.—National Aniline Div.: James G. Fox, Jr. named exec. VP, and **J. Warren Carey** appointed a VP.

Solvay Process Div.: Arthur Phillips, Jr., previously dir. of sales, promoted to VP. He is succeeded by **Verne W. Aubel, Jr. Robert L. Reynolds** named asst. dir. of sales, and **G. Richard Barclay** appointed mgr. of the sales dept.'s organic chemicals section.

Harry C. Todd promoted from mgr.—advertising and sales promotion to newly created post of mgr. of distributor sales. He is succeeded by **William J. Cannon.**

Barrett Div.: Dr. John N. Cosby, formerly asst. dir. of Allied Chemical's Central Research Laboratory, Morristown, N. J., named dir. of research and development for Barrett. **Ralph A. Stevens,** previously mgr.—market analysis, mechanical goods div. of U. S. Rubber Co., joined the div. as mgr.—market research.

Baldwin-Lima-Hamilton Corp., Hamilton Div. Distribution system for line of mechanical and hydraulic presses changed and following distributors appointed:

Frank O. Walsh, Jr., 401 Volunteer Bldg., Atlanta 3, Ga.—Ga., S. C., and N. E. Fla. **Addy & Luby Machinery Co.,** 8601 Second Blvd., Detroit 2, Mich.—all of Mich., except the four counties near Chicago, Ill., and the major automobile companies. **Anschuetz Machinery Co.,** 1500 Park Ave., Hamilton, O.—S. W. Ohio, S. Ind., and Ky. **McVoy-Hausman Co.,** 2024 Sixth Ave., N. Birmingham, Ala.—Ala., N. W. Fla., E. Miss. and Tenn. **General Equipment, Inc.,** P. O. Box 6206, Station B., Miami 36, Fla.—S. Fla. **Selby-Horan Machine Tools Co.,** 3003 Louisiana Ave., Houston 6, Texas—S. Texas. **Hamilton Machinery Co.,** 918 W. Commerce St., Dallas 22, Texas—N. Texas. **Tidewater Supply Co., Inc.,** 501 W. 24th St., Norfolk 1, Va.—Va. and N. C.

Spencer Chemical Co., Kansas City, Mo.: **Dr. A. F. Helin** appointed staff specialist in the Research Center's Plastics Research Dept., specializing in research in polymers. **Karl J. Bombaugh** named sr. staff member specializing in analytical chemistry in the Chemical Research Dept. Both scientists were previously with American Cyanamid Co.

Reichhold Chemicals, Inc., White Plains, N. Y.: **Ralph T. Urich,** VP-gen. sales mgr., named to the board of directors.

R. T. Urich

Martin P. Kerins and **Jack Siegelbaum** appointed products mgrs. for the chemical div. Between them, they will have responsibility for sales of the basic chemicals currently manufactured by RCI.

R. H. Windsor (Holdings), Ltd., proprietors of **R. H. Windsor, Ltd.,** Chessington, Surrey, England, acquired a majority shareholding in **Webley & Scott, Ltd.,** gunsmiths and engineers.

In consequence of the fusion of the two engineering companies, Webley & Scott, Ltd. acquired a majority shareholding in R. H. Windsor, Ltd. The amalgamation will provide added production capacity for Windsor plastics processing machines.

Monsanto Chemical Co., Plastics Div.: Dr. Robert O. Symcox joined the div. at Springfield, Mass., after serving with **Monsanto Chemicals, Ltd.,** England.

Reino A. Jarvi appointed research group leader at the Santa Clara, Calif., plant laboratory.

Robert R. Osburn promoted from sr. engineer to chief planner and coordinator, planning and scheduling section, maintenance dept., at the Texas City, Texas, plant. **Leonard Schwab** named maintenance supt. in the same dept.

Thompson Chemical Co., Pawtucket, R. I.: **Victor J. Baxt** elected VP and gen. mgr. **Allen E. Polson** appointed to the newly created post of dir. of sales. He has devoted his entire business career to the plastics and synthetic polymer industries. Associated with Du Pont in various capacities, including research and patent law, Mr. Polson was mgr. of the plastics dept. of Goodyear Tire & Rubber Co.'s Chemical Div. for the past 5 years.

A. E. Polson

Thompson Chemical Co., supplier of Truflex plasticizers for many years, entered the synthetic polymer field several years ago with construction of a large modern vinyl resin facility at Hebronville, Mass.

Chemetron Corp., Girdler Process Equipment Div., established a sales office for Thermex high-frequency dielectric heating equipment at 855 Board of Trade Bldg., Chicago, Ill. **Frank Vance,** formerly a field engineer, will be in charge of sales and engineering services from the Chicago office.

Ciba Co., Inc. merged its Plastics Div. of 627 Greenwich St., New York, N. Y., with its manufacturing affiliate, **Ciba Products Corp.,** which will be the headquarters for the company's management, sales, and tech. service personnel for Araldite epoxy resins.

Frank E. Pschorr named mgr.—structural technical service and development laboratories. **O. L. Nikles** becomes mgr.—coatings technical service and development laboratories.

The company will continue to make its headquarters in Kimberton, Pa., until new research and production facilities are completed in Toms River, N. J., and its administrative and sales offices are transferred to new quarters in Fair Lawn, N. J.

Southeastern Plastics Sales Co., 610 Morosgo Dr., N. E., Atlanta 5, Ga., appointed distributors to the marine and industrial trade of fibrous glass fabrics produced by **Exeter Mfg. Co.,** Exeter, N. H.

Southeastern also named exclusive distributor in seven southern states of Selectron polyester resin products manufactured by **Pittsburgh Plate Glass Co.**

Engineering Plastics Co., 45 E. Walnut St., Pasadena, Calif.: **Russell M. Gilbert** named admin. asst. in charge of purchasing, production and qual-

Companies . . . People

ity control. **Earl Smith** appointed shop supt. to direct manufacture of thermoplastic sheet material, formed parts, etc.

Foster Grant Co., Inc.: J. Joseph Kelly named to newly established position of dir. of marketing for polymer products and petrochemicals. He was previously VP—sales for Package Machinery Co., East Longmeadow, Mass., and also for the Reed-Prentice Div.

J. J. Kelly

The company opened a sales office at 2970 W. Grand Blvd., Detroit, Mich., headed by **Frank Giordano**; and at 4900 W. Madison St., Chicago, Ill., under **Thomas Egan**.

Warehouses have been added in Worcester, Mass.; Chicago, Cleveland, Ohio; Detroit; Kansas City, Mo.; and Minneapolis, Minn.

Columbian Carbon Co., Carbon Black & Pigment Div.: C. O. Davidson appointed gen. sales mgr.

The Tech. Dept. has been expanded and now includes new product evaluation under **J. W. Snyder**, who was named tech. dir.; **R. A. Emmett** appointed asst. tech. dir.; **L. J. Venuto** now assoc. tech. dir. working on tech. service and evaluation of industrial blacks and dispersions.

M. C. Gill Corp., plastics laminators, S. El Monte, Calif.: **Bernard J. Tromp** heads new laboratory.

Nicholas J. Gyopyos assigned supv. of new **Honeycomb Sandwich Div.** and liaison officer with the military.

Midland-Ross Corp., John Waldron Corp., moved its office personnel from 201 N. Wells St., Chicago 6, Ill., to Mount Prospect, Ill.

Edmund A. Stec joined the sales engineering staff in Chicago, and **R. William Raas** named sales engineer in the machinery div., New Brunswick, N. J.

Hooker Chemical Corp.: Thomas E. Moffitt, pres., named chief exec. officer, succeeding **R. Lindley Murray**, who remains chrmn. of the board.

Sommers Plastic Products Co., distributor of supported and unsupported vinyl sheeting for **General Tire & Rubber Co.**, opened sales office and show room at 330 Fifth Ave., New York, N. Y.

The Budd Co., Philadelphia, Pa.: **Philip W. Scott**, formerly admin. VP of Byron Jackson Div., Borg-Warner Corp., named group VP responsible for the operations of **Continental-Diamond Fibre Corp.** and various other subsidiaries.

Continental-Diamond Fibre Corp.: George H. Shima, previously dist. sales mgr. in Cleveland, Ohio, appointed CDF rep. in the new Western Sales Div. office, 3141 Century Blvd., Los Angeles, Calif.

Larson Distributing Co., 400 Quivas St., Denver, Colo., appointed Colorado distributor for **Formica Corp.**, subsidiary of **American Cyanamid Co.**

R. P. M. Corp., 1245 Seventh St., Denver, former Formica distributor in this region, will now do specialty fabricating with decorative laminates.

Milprint, Inc., Milwaukee, Wis.: **William Heller, Sr.** named hon. chrmn., **Roland N. Ewens** appointed chrmn. and chief exec. officer. **Arthur Snapper** promoted from exec. VP to pres.

The company, a subsidiary of **Philip Morris, Inc.**, tobacco company, is a leading converter of flexible packaging materials.

Air Reduction Chemical Co.: Robert C. Gilardi appointed dist. mgr., Chicago, Ill., in charge of Midwest sales activities.

Roger C. Schmalfuss named West Coast sales rep. with offices at Berkeley, Calif. **William F. Lehr** is southeastern and middle Atlantic states sales rep., and **Charles T. Law** appointed New York and New England sales rep. Both will be based at Airco's New York office.

Atlas Powder Co.: Dr. Frederick M. Robbins and **Herbert L. Jones, Jr.** appointed sr. chemists in the product development dept. of the Chemicals Div.

Paramount Plastic Fabricators, 13215 Laureldale Ave., Downey, Calif., acquired the interests of **Charles (Chuck) Petrie**, owner of **Industrial Plastic Fabricators**, Los Angeles, Calif. Mr. Petrie was named gen. mgr. and moved his equipment to the new location. He specializes in the fabrication of custom fittings for rigid PVC pipe, fume hoods, duct work, and tanks, all of which will now be handled by Paramount.

The company has also been granted exclusive rights to manufacture the Glis-San swimming pool chlorinator, constructed of rigid vinyl.

Continental Can Co. integrated the **Conolite Dept.**, consisting of plastics laminates manufacturing, sales, and research, with comparable functions of the company's **Flexible Packaging Div.**

R. J. McLaughlin, gen. mgr. of Conolite named mgr. of manufacturing for the Flexible Packaging Div.

J. O. Otis and **R. E. Fitzgerald**, sales mgrs. for industrial and decorative Conolite, respectively, retain their positions in the new divisional structure, but will now report to **F. P. Winslow**, Flexible Packaging gen. mgr. of sales.

Gering Products, Inc., Kenilworth, N. J., opened sales office at 103 Holden St., Holden, Mass. **Julian Lanza** named mgr.

The Dayton Rubber Co., Dayton, Ohio: **Maj. Gen. Gerald J. Higgins** named asst. to the pres. on military matters.

American Latex Products Corp., Hawthorne, Calif.: **Del Holter** appointed contracts administrator. **John N. Kempf** named adhesive chemist.

Pacific Polymers, Inc.: Glenn A. Wintemute named mgr.

Durable Industries, Inc., and its associated firms, **Durable Formed Products, Inc.; Techni-Plastics, Inc.;** (both companies carry out thermoplastic forming and fabricating); **Air-O-Flow Industries, Inc.**, (manufacturer of thermoforming machines); and **Eastern Sales Associates**, opened executive and sales offices at 74 Varick St., New York 13, N. Y.

Fiber-Resin Corp., Burbank, Calif., appointed distributors in the southern Calif. area for the Peterson fibrous glass spray gun.

Association of Consulting Chemists & Chemical Engineers, Inc.: Dr. Erwin DiCyan and **Dr. Foster Dee Snell** elected pres. and VP respectively for a 1-year term.

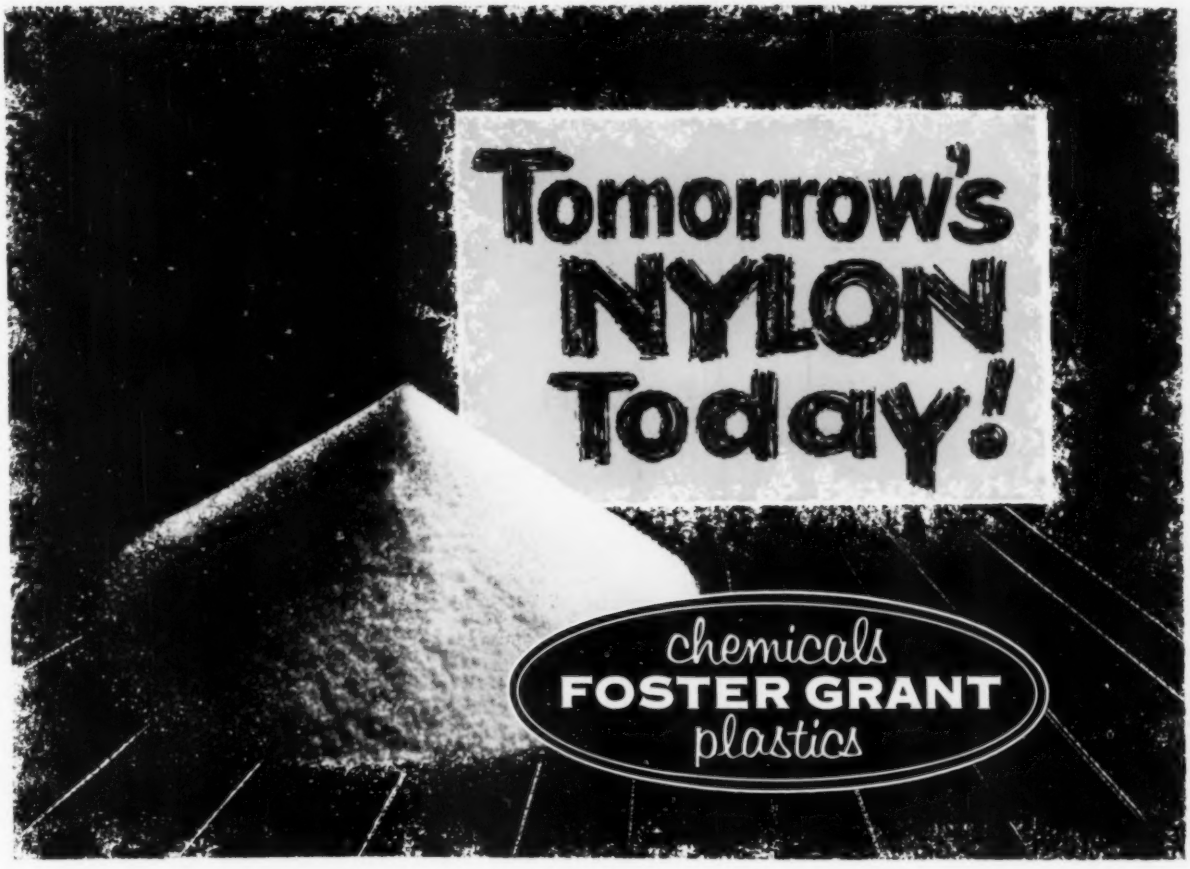
Borden Chemical Co.: L. George Hoth, formerly merchandising mgr.—consumer products dept., promoted to mgr.—advertising and merchandising.

Thomas B. MacDonald named plant engineer at the company's PVC operation in Leominster, Mass.

Apponaug Roto-Graving Co., 65 Centreville Rd., Apponaug, R. I., is a new corporation engaged in the production of engraving copper rolls or cylinders for printers of plastics, foil, paper, etc. **Robert M. Johnson** is pres.

Plastic Center Inc., 228-230 N. 15th St., Philadelphia, Pa., appointed dealer for **Synthane Corp.**, Oaks, Pa., manufacturer and fabricator of industrial laminates.

New England Laminates Co., Inc., Stamford, Conn.: **James F. Snowden**



EXCITING NEW FOSTA NYLON 62-ASK

OFFERS 7 BIG MOLDING ADVANTAGES

ONLY
FOSTER GRANT
COMBINES:

- ★ Its own monomer plant
- ★ Its own polymerization plant
- ★ Its own nylon plant
- ★ Precise color matching
- ★ Precise quality control
- ★ 40 years of molding experience
- ★ Machine design
- ★ Tool and die services
- ★ Marketing aid
- ★ Technical assistance

TO ASSURE SUPERIOR
QUALITY OF **YOUR** PRODUCTS

A continuous research program, plus 40 years of molding experience, has resulted in a revolutionary new FOSTA NYLON formulation. A completely homogeneous crystalline structure, plus a greater degree of dimensional stability in the finished product, add up to give you these exclusive advantages in FOSTA NYLON 62-ASK:

1. **Increased surface hardness**
2. **High abrasion resistance**
3. **Shorter molding cycles (extremely fast setting)**
4. **Eliminates internal stresses**
5. **Eliminates uneven shrinkage and warpage**
6. **Increased toughness**
7. **Eliminates the use of mold release agent**

These and other advantages are yours with FOSTA NYLON 62-ASK, the newest and most exciting nylon on the market today. Write for detailed literature. Our technical staff is at your service.

FOR THE **PLUS** IN PLASTICS, LOOK TO FG

FOSTER GRANT CO., INC.

LEOMINSTER, MASS. **MANCHESTER, N. H.**

FOSTER GRANT ALSO MANUFACTURES PRODUCTION PROVED FOSTARENE POLYSTYRENE AND FOSTA TUF-FLEX POLYSTYRENE

Companies . . . People

named asst. tech. dir. **Dr. Donald E. Edgar** assumed responsibility for resin formulation, and **Glen J. Taylor** will supervise product-testing, -evaluation and -development.

D. N. & E. Walter & Co., 562 Mission St., San Francisco, Calif., appointed by the **Goodall Vinyl Fabrics Div., Goodall-Sanford, Inc.**, member of **Burlington Industries, Inc.**, as distributor of Burmillion vinyl fabrics in seven western and southwestern states, and in Honolulu, Hawaii.

Ardmore M. Willer appointed sales mgr. of **West Instrument Corp.**, Chicago, Ill., manufacturer of temperature control and recording instruments.

Howard J. Peppercorn named mgr. of **The General Tire & Rubber Co.**'s Marion, Ind., plant which produces urethane foam and a line of reinforced plastics products.

F. Theodor Hahn appointed mgr. of the **F. J. Stokes Corp.** sales office at 7 Bobrich Dr., Rochester 10, N. Y.

Dr. Edward T. Severs, formerly tech. dir. of Natvar Corp., manufacturer of plastics and coatings for electrical insulations, joined **Sun Oil Co.**'s product development staff, Research & Development Div.

Edward W. Melvin appointed asst. dir. of sales, Resin Products Dept., Plastics Div., **Celanese Corp. of America.**

Markus D. Royen elected VP and dir. of research of **Apex Tire & Rubber Co.**, Pawtucket, R. I., manufacturers of vinyl compounds, etc.

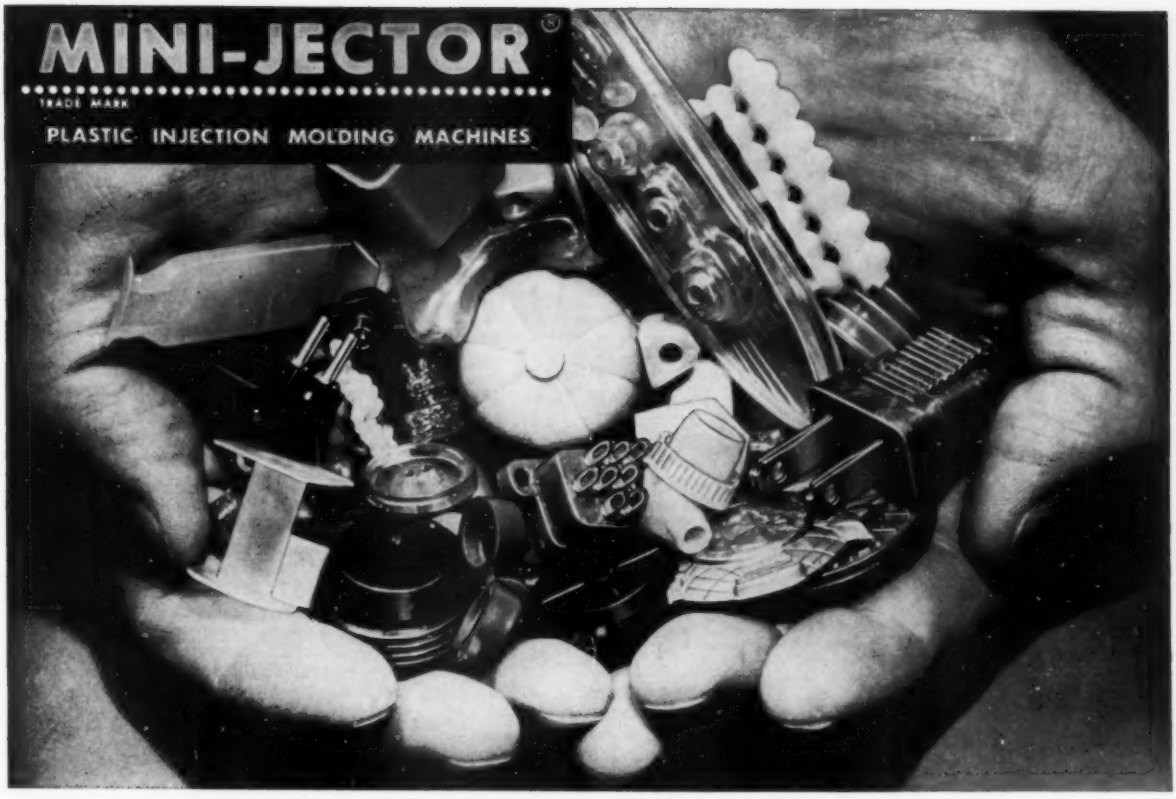
Robert J. Frawley joined the Color Div., **Ferro Corp.**, Cleveland, Ohio, as a sales engineer specializing in colorants for plastics.

Thomas S. McCrory, named regional mgr. of West Coast sales organization of **Wheelabrator Corp.,** will headquarter in Los Angeles, Calif.

Glenn M. Litsinger, 128 Third St., N. E., Hickory, N. C., named sales rep. for the southern states by **Dawbarn Brothers, Inc.,** Waynesboro, Va., extruders of filaments.

K. E. Munro promoted from Chicago, Ill., dist. mgr. to sales supv. for **Fiberfil, Inc.,** Warsaw, Ind., manufacturers of reinforced injection molding compounds.

C. W. Taylor, former process engineer in the Research Div., **Goodyear Tire & Rubber Co.,** who played an important role in the development



MORE VARIETY AT LOWER COST

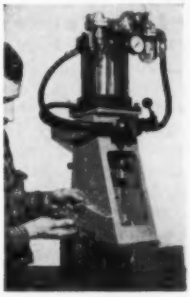
One MINI-JECTOR user saved over $4,000 in mold costs on one of the above items alone. Details on request.

If your production requirements are such that big press tooling can be avoided, you can be sure of substantial savings. The more the variety, the bigger the savings. Flexible, efficient MINI-JECTOR plastic injection molding machines answer the critical need for lower cost development and production of fast-changing varieties of small precision-molded plastic items. Savings begin with low initial machine investment (some under $1,000) and mold blanks (as low as $29.50).

More important are the major savings in time, trouble and money developing and producing wide varieties of items by eliminating complex, costly big press tooling where not needed.

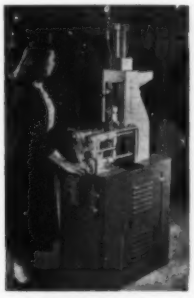
MINI-JECTOR solves your tight margin runs, from test samples to steady production of 1/3 oz. to 1½ oz. capacity; also, tricky insert or loose core molding in all thermoplastics, including Nylon. Simple to operate; lever and push-button control models; air or hydraulic power to fit your facilities.

See complete MINI-JECTOR Line of Machines and Accessories. Illustrated catalog presents detailed specifications; technical data on performance, applications, prices; and the newest developments in plastic injection molding of small parts, including those involving inserts or loose cores. Shows how MINI-JECTOR has modernized methods in hundreds of plants. Mailed free at your request.



"Wasp"

"Eldorado"



"Hornet"

There are **three basic MINI-JECTOR models**—"Wasp," "Eldorado" and "Hornet" series—with many variations of each to meet your special requirements. They are offered with air or hydraulic power. Some have lever control, some push button controls, some with semi-automatic operation. See catalog.

NEWBURY INDUSTRIES, Inc.
Box 121, Newbury, Ohio

Companies ... People

of Vitel polyester material, named mgr. of the newly created Vitel Products Development Dept., which will handle problems of application and sales service for Vitel resins and Videne laminating film.

Louis B. Allen, formerly sr. research chemist with International Resistance Co., joined plastics laboratory of **International Business Machines Corp.,** Endicott, N. Y.

Allan E. Settle, previously with the public relations staff of Monsanto Chemical Co., named dir. of public relations, **Manufacturing Chemists' Association, Inc.** He succeeds **George M. Worden,** who resigned to open his own PR firm in Washington, D. C.; he will continue with MCA in a consulting capacity.

James E. Parkhill, previously with Rainbow Plastics, joined **Barnett J. Danson & Associates,** Toronto, Canada, as VP. The company specializes in processing equipment for the plastics industry.

Clifford C. Burke appointed sales engineer at the La Verne, Calif., sales office of **Taylor Fibre Co.**

J. Gilbert Mohr joined **L. O. F. Glass Fibers Co.,** Toledo, Ohio, as engineer in the product planning dept.

John Lyon Collyer, chrmn. of the board, **The B. F. Goodrich Co.,** relinquished the post of chief exec. officer, but will remain chrmn. **J. Ward Keener,** pres., became chief exec. officer.

John S. Efroymson, formerly with B. F. Goodrich Chemical Co., joined **Flexible Products Co.,** Marietta, Ga., as tech. dir.

Thomas L. Bonnitt appointed mgr.—market development at **Morningstar-Paisley, Inc.,** New York, N. Y. The newly created dept. will evaluate and develop plastisols, adhesives, and other products.

Paul F. Baker named vinyl sales representative in the Midwest for **Escambia Chemical Corp.**

Dr. Robert D. Levering, Dr. Robert D. Mair, and **Dr. Robert H. Ralston** named sr. research chemists by **Hercules Powder Co.**

C. D. (Bing) Miller, previously sales mgr. of Lewis Welding & Engineering Corp., Cleveland, Ohio, named sales mgr. of the newly formed plastics machinery div. of **Cast-Master, Inc.,** Bedford, Ohio.

Aaron Kostman, 806 Frick Bldg., Pittsburgh, Pa., appointed exclusive sales agt. to resale outlets in W. Va. and the western portion of Pa. for the hardware and fastener products of **Gries Reproducer Corp.,** New Rochelle, N. Y.

Albert A. Nelson named commercial research mgr. of **Emery Industries, Inc.,** Cincinnati, Ohio.

J. Henry Richmond, pres., **Potdevin Machine Co.,** Teterboro, N. J., elected pres. of the **Packaging Machinery Manufacturers Institute, Inc.**

Col. Walter L. Savell, formerly with Remington Rand, Inc., now associated with **The Case-Stanley Marketing Consultants, Inc.,** Westport, Conn.

Corrections

MODERN PLASTICS *Encyclopedia Issue, 1959:* The following firms should be listed in the Directory Section under the classifications and on the pages indicated:

Anchor Plastics Co., Inc., 36-36 36th St., Long Island City, N. Y. (*as an Encyclopedia advertiser): under the custom molders and extruders listing, page 1155, the number of extrusion machines in operation by Anchor should be corrected to read 11—2½-in. machines instead of 11—2-in. machines.

Aries Laboratories, Inc., 45-33 Davis St., Long Island City, N. Y., should be listed as a manufacturer of epoxy molding compounds, page 1101, and as a manufacturer of epoxy resins, page 1105.

Atlas Coatings Corp., 5-35 47th Ave., Long Island City 1, N. Y., should be listed as a manufacturer of inks for printing plastics, page 1126.

Fibercast Co., Div. of The Youngstown Sheet & Tube Co., Box 727, Sand Springs, Okla., should be listed under laminators, page 1165 as a manufacturer of molded laminate tubing (pipe) with O.D.'s of 2⅜, 2⅞, 3½, and 4½ in. in standard lengths of 21 feet. The company also specializes in fittings for pipe and tubing. In addition, the company should be listed under Reinforced Plastics Processors, page 1174, as follows: Types of molding done and kind of molds used: matched die molding; premix molding, including polyester and epoxies. Number of presses, platen area, and daylight space of each press: 3—25-ton presses, 18 by 18 by 18 inches. Type of resins and reinforcements used: epoxy and braided glass made by patented centrifugal casting process. Type of fabrication done: special fabrication and assemblies, especially chemical pipe according to specification. Under Tradenames, Fibercast, reinforced plastic pipe and fittings, should be listed on page 1184; X-trude, thermoplastic pipe, should be listed on page 1193.

General Electric Co., Chemical and Metallurgical Div., Chemical

Materials Dept., 1 Plastics Ave., Pittsfield, Mass.: manufacturer of phenolic and premix (glass-polyester) molding compounds, page 1101; manufacturer of phenolic resins, page 1105; manufacturer of silicone synthetic rubber, page 1107. The company should also be listed in the Alphabetical Section, page 1201.

Interplastics Corp., 20 E. 56th St., New York, N. Y., was inadvertently omitted from the special Advertisers' Index, page 40, under the following categories: Acrylic; Cellulose Acetate; Cellulose Acetate Butyrate; Cellulose Propionate; Custom Compounding; Nylon; Polyethylene; Polystyrene; Reprocessors; and Vinyl.

Metal & Thermit Corp., Rahway, N. J. (*as an Encyclopedia advertiser): manufacturer of organosols and plastisols, page 1102; stabilizers, page 1109.

Metropoliton Plastics Corp., 865 Grand St., Brooklyn, N. Y., should be listed as a manufacturer of polyethylene film, page 1099.

Mitchell Specialty Div., Industrial Enterprises, Inc. (formerly United Specialties Co. of Illinois), Edmund and Shelmire Sts., Philadelphia 36, Pa. (*as an Encyclopedia advertiser): manufacturer of proportioning (and metering) systems, page 1122. The company also does casting of plastics, page 1131, and should further be listed in the Alphabetical Section, page 1212.

Pantex Mfg. Corp., Pawtucket, R. I. (*as an Encyclopedia advertiser): manufacturer of boilers, page 1119; manufacturer of steam generators, page 1121.

Sealomatic Electronics Corp. (*as an Encyclopedia advertiser): manufacturer of heat sealing machines, page 1113, and heat sealing equipment, page 1121. The company should also be listed in the Alphabetical Section, page 1210. Main office of Sealomatic is located at 429 Kent Ave., Brooklyn 11, N. Y.; the Los Angeles address listed in the directory is a branch office.

Springfield Cast Products, Inc., 124 Switzer Ave., Springfield, Mass., should be listed as a manufacturer of cast aluminum molds, metal sprayed molds, and reinforced plastics molds, page 1140. The company should also be listed as a polisher of molds, page 1142.

Westchester Plastics, Inc., 326 Waverly Ave., Mamaroneck, N. Y. (*as an Encyclopedia advertiser) should be listed as a manufacturer of color dispersions in all thermoplastic materials on page 1095.

"Plastic Products" (MPL, Sept. 1958, p. 115). We have been informed that the term "Snap-On" in connection with pipe insulation has been registered at the U. S. Pat. Office by Gustin-Bacon Mfg. Co., Kansas City, Mo., and that that firm has exclusive right to the use of that mark on pipe insulation.—END

Classified Advertisements

EMPLOYMENT • BUSINESS OPPORTUNITIES • USED OR RESALE EQUIPMENT

Machinery and Equipment for sale

FOR SALE: Banbury 00, #1, 3A. Calenders 3 Roll 45"x18", 6 Roll 12"x5". 1,000 ton Hobbing Press. Stokes 3 DDS2, 1 T, 1 RD3, 1 B. Baker Perkins 100 gal. S.S. double arm 50 HP jacketed vacuum hyd. tilt, 100 gal. double arm steel. Hydraulic Pumps. Powder Blenders. Ball Mills. Machinecraft Corporation, 800 Wilson Ave., Newark, N.J. Mi 2-7634.

FOR SALE: One (1) two-color Markem Dial Press. Original Cost $8500. Slightly used. $4,000. One (1) one-color Markem Dial Press. Original cost $6500. Slightly used. $3,000. Three (3) Arnold Presses, 1958 Models. Original cost $6,000 without index head. $7,750 with index head. Will take substantial reduction from original cost. All machines guaranteed to be in perfect working condition. Suitable for side-printing on containers, and also for printing covers. Reply Box 5118, Modern Plastics.

FOR SALE: One 1951 Stokes Model 741 50-ton Compression Molding Press, platen size 15"x13". First class condition. Slater Electric & Mfg. Co., Inc., 45 Sea Cliff Avenue, Glen Cove, New York. ORiole 6-1100.

R.C.A. ELECTRONIC METAL DETECTOR: And accessory equipment—like new. 46 x 15 inches. 27 inch inspection area. Detects all metals. 110-120 volts. 50-60 cycles. 140 watts. Cost $2,200.00 new. Selling at big discount. Write Minn. Artistic Prod., 200 4th St. S. E., Mpls., Minn., Ph. Federal 8-6812.

FOR SALE: 1 1958 DeMattia 4-6 oz. K2, hardly used. 1 1948 8-10 oz. Reed-Prentice, excellent condition, located South. Will sacrifice. Reply Box 5112, Modern Plastics.

FOR SALE: 3—750 gal. Stainless Reactors. 11—Baker-Perkins 200 gal. Sigma Blade Mixers. Pfaudler glass-lined Reactors: 750, 100, 30 gal. Farrel-Birmingham 1500 HP horiz. reducer, 5:1 ratio. Ribbon Mixers 200, 75 cu. ft. Stokes Tablet or Preform Presses, Rotary Cutters, Mills, etc. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

FOR SALE: H.P.M. Rubber Injection molders, 21½"x28" mold space, steam heated platens. Watson-Stillman 300 ton semi-automatic compression molding press (1947) self-contained mold size 34"x27". Watson-Stillman 250 ton 28"x24". Watson-Stillman 140 ton 22"x16". Waterbury Farrel 85 ton 20"x24". W.F. 63 ton 15"x15". Laboratory presses—15 ton 10"x8" and 10 ton 6"x6" platens. (2) 8 ounce Reed Prentice injection molding machines and (1) 8 ounce Lester Phoenix (late) with nylon attachment. Scrap cutters, valves, accumulators. Hydraulic Presses—all sizes. Aaron Machinery Co. Inc., 45 Crosby St., New York, N.Y. Tel.: WAlker 5-8300.

FOR SALE: No. 1-A Wheelabrator Multitable with six 26" auxiliary tables; ideal for deflashing of large molded plastic parts. In excellent operating condition—complete with dust collector and all electrics—subject to prior sale. Universal Machinery & Equipment Company, 1630 North 9th Street, Reading, Pa.

FOR SALE: 1 Hartig 3¼" electrically heated plastics extruder; 1 Cumberland 7" Stair Step dicer; 4 compression molding presses, 300, 200, 100 and 40 tons; 3 Ball & Jewell rotary cutters 15, 5 and 2 HP; also mills, mixers, etc. Chemical & Process Machinery Corp., 52 9th St., Brooklyn 15, N.Y., HY 9-7200.

FOR SALE: Injection molding machine—8 ounce Leominster Tool Injection Molder for quick sale. No reasonable offer refused. May be seen running. Call or write Tee Vee Toys, Inc., 124 Water Street, Leominster, Mass. Telephone Leominster Keystone 4-8378.

FOR SALE: Skin Packaging Machine in excellent condition. 2 years old. Manufactured by Packaging Products Co., Culver City, Calif. 36x36" Platen Double Ends. One Abbot Slitter. Price of 2 pieces $5,400.00. De & De Plastics Assemblies, Inc. 2750 Nina Street, Pasadena, Calif.

FOR SALE: (6) 100 ton, 10" ram, 10" stroke @ $1250; (7) 200 ton, 9" stroke, 14" ram, 36x36, @ $2160; (6) 200 ton, 9" stroke, 15" ram, 30x30 @ $1850; (1) ton complete, 18x18 @ $1850; (1) 200 ton 16" ram 30x30 @ $2460; (2) 200 ton 16" ram, 42x42 @ $2850; (1) 200 ton, 15" ram, 42x42 @ $2600; (3) 250 ton (2) 12" ram, 30x60 rebuilt @ $3675. Hydraulic Sal-Press Co., Inc., 386-90 Warren Street, Bklyn., N.Y.

LIQUIDATION SALE: molding plant: (2)—325 ton French Oil compression presses. (1)—300 ton Erie compression press. (1)—100 ton compression press. (3)—75 ton transfer presses. (1)—No. 5½ T Colton preform machine. (1)—3 DT Colton tablet machine. Reply Box 5108, Modern Plastics.

FOR SALE: 1 Baker Perkins 15USE, 100 gal. all stainless double arm Vacuum mixer; 1—Baker Perkins size 15VUUM, 100 gal. double arm mixer, 100 HP motor; 1—Baker Perkins size JNM 100 gal. double arm mixer; 6—Day 250 and 100 gal. double arm mixers; 1—Ball — Jewell #1 Rotary Cutter; 2—Two Roll Mills 6"x12"; 6—Stokes model DD2, DS3, D3 and B2 Rotary Preform presses; 4—Stokes model "R" single punch Preform presses; also: Sifters, Banbury mixers, Powder mixers, etc., partial listing, write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

FOR SALE: 2 oz. Van Dorn semi auto. 4 oz. Lewis, 1954—$3,000. 4/6 oz. R-P, 1955. 4 oz. vert. DeMattia. 8 oz. R-P, 1946—$5,000. 12 oz. W-S Model E—$6,000. 12 oz. Lester w/solid frame—$4,000. 16 oz. vert. Impco. 48 oz. W-S 1950. Two head bottle blowing machines. Ovens, grinders, powder mixers, injection molding machines 1 oz. to 60 ozs. never used and used. Acme Machinery & Mfg. Co., Inc. 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900. 102 Grove Street, Worcester, Mass. PLeasant 7-7747. 5222 W. North Ave., Chicago, Illinois, TUxedo 9-1328.

FOR SALE: Baldwin-Southwark 200 ton semi-automatic transfer molding press. 2500 ton downstroke 54" 102". French Oil 250 ton 38"x28". 200 ton hobbing press. 200 ton 16" record presses. D & B 140 ton 36"x36". French Oil 120 ton self-contained. W. S. 120 ton 24"x24". Hydraulic pumps and accumulators. Van Dorn 1 and 2 ounce injection machines. Lester 16 oz. complete. Other sizes to 100 oz. Baker-Perkins and Day jacketed mixers. Plastic cutters. Oxford 57" slitter. Seco 6"x13" and 8"x16" mills and calenders. Adamson 6" rubber extruder. Oil and Elect. Plastic extruders, lab to 6", Single & Rotary preform press ½" to 4". Partial listing. We buy your surplus machinery. Stein Equipment Co., 107—8th St., Brooklyn 15, N.Y.

FOR SALE: Used injection molding machines, extruders, processing equipment; pumps, valves, machine parts, motors, etc., for replacement parts and do-it-yourself companies. Zimmerman Machinery Co., 46 Easton Road, Westport, Conn., CApital 7-0472.

EXTRAORDINARY OPPORTUNITY: Battery of unused Farrel-Birmingham 14"x30" Late Style, Top-Cap Rubber or Plastic Mills each one with uni-drive; may be purchased individually. Write—wire or phone collect STerling 8-4672. First Machinery Corp., 209 Tenth St., Bklyn. 15, N.Y.

JUST SECURED: Most Modern Packaging And Processing Machinery, available at great savings—4—Hayssen model F compaks with net weight scales, bulk and dribble feeds, electric eyes. 4—Ceco model 40-9½-GG automatic adjustable cartoning units. Also model TT. Package Machinery, Hayssen, Scandia, Wrap King, Miller Wrappers. 1—Pneumatic scale automatic carton feeder. Bottom Sealer and Top Sealer with interconnecting conveyors. 6—Fitzpatrick model D-6 stainless steel comminuters. Day, Robinson 50 to 10,000 lb. dry powder mixers. Baker Perkins, from 2 to 100 gal., double arm mixers, jacketed and stainless steel. Stokes DD2 and Eureka tablet machines. Complete details and quotations promptly submitted. Union Standard Equipment Company, 312-322 Lafayette Street, New York 12, N.Y. Phone: **Canal 6-5334.**

(Continued on page 246)

(*Continued from page 244*)

FOR SALE: One 1951 and one 1954 model 16 oz. Watson Stillman 385 ton plus injection machine. 47½ horse power. Fast cycle. Now running. First class condition. Price, photographs, spare parts list available on request. Reply Box 5122, Modern Plastics.

FOR SALE: 1000 ton and 2000 ton hydraulic presses—1 oz. model H-200 Van Dorn injection machine—3 oz. Fellows, 8 and 12 oz. Lesters, 50 oz. Impco—400 ton 36"x36" vertical presses—No. ½ and 1½ Ball and Jewell grinders—Carver laboratory presses and others to 75 ton—6"x13" laboratory mills—Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N.J., phone DE 4-1615—Cable address Plasmex-Boonton.

Machinery wanted

WANTED TO BUY: Used injection molding machines, oven, granulators. One machine or complete plant. Acme Machinery & Mfg. Co. Inc., 20 South Broadway, Yonkers, N.Y. YOnkers 5-0900, 102 Grove Street, Worcester, Mass., PLeasant 7-7747, 5222 West North St., Chicago, Illinois, TUxedo 9-1328.

WANTED: Late model vacuum forming machine with platen area of about 24" x 30". Prefer vacuum, drape, and plug assist features. State age, main features, and price. Reply Box 5114, Modern Plastics.

WANTED: Moslo Duplimatic Injection Molding machine. State model, year purchased and price. Union Tool & Engineering Company, 332 Jones Street, Dayton 10, Ohio.

WANTED: Used injection molding machines, extruders, plastics processing equipment. From one machine to a complete plant. We can also assist you in selling company. Zimmerman Machinery Co., 46 Easton Road, Westport, Conn., CApital 7-0472.

WANTED TO BUY: Oven, electrically heated, 20 to 40 trays for plastic pellet drying. Reply Box 5101, Modern Plastics.

WANTED: 6"x13" Laboratory 2-roll mill in good condition. Rolls cored for heating and chrome plated. Ratio around 1.4:1. Write: Industrial Vinyls, Inc., 5511 N.W. 37th Avenue, Miami, Florida.

Materials for sale

FOR SALE: Plexiglas V-100, first regrind, comparable to virgin. Constant supply, 2M to 3M lbs. per month. Original use for optical lenses. Guaranteed not contaminated. Packed in original drums. Price $.32 per lb. Reply Box 5110, Modern Plastics.

VIRGIN STYRENE FOR SALE: Cut-Costs—We offer 500,000# Virgin Styrene High Impact Styrene in natural, all standard colors, and most spec. colors. Med. Impact Styrene in natural, all standard colors, and most spec. colors. Gen Purpose Styrene in crystal, all standard colors, and most spec. colors. Write us for our low price quotations. We will match your color requirements. Our compounding plant and warehouse is located in Erie, Pa. and deliveries are made in our own trucks. Call, wire, or write Erie Plastics Co., P.O. Box 1068, Erie, Pa., Phone 22-503.

FOR SALE: 2,600 lbs. virgin transluscent white hi impact .060 Styrene. 150 sheets 36 x 93. 200 sheets 32 x 93. In original extruder's wrappings. Available for inspection Chicago. Lot price 29¢ lb. Reply Box 5111, Modern Plastics.

Materials wanted

PLASTIC SCRAP: all types and grades purchased, large and small quantities. Top prices. Send description, and small representative sample to: Success Plastics Corporation, P. O. Box 506, Indianapolis, Indiana, LIberty 6-2919.

WANTED: We are interested in purchasing large quantities of clean reground or unground clear Plexiglas or Lucite, suitable for injection molding. Also large lots of clean reground and unground general purpose and impact Styrene. Reply Box 5117, Modern Plastics.

BADLY NEEDED: High impact styrene—straight colors as well as mixed colors. We purchase all other types of thermo plastics in any form. For highest prices write, wire or phone collect. Philip Shuman & Sons, 15-33 Goethe Street, Buffalo 6, New York, Tel.: HUmboldt 1811.

WANTED: Plastic scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 514 West 24th Street, New York 11, N. Y.

STYRENE WANTED: Need large quantities of reground or offgrade virgin general purpose Styrene in crystal, transparents, and standard colored white, red, green, yellow, or blue. Guaranteed highest prices paid. The Cane Co., Box 352, Highland Park, Ill.

WANTED: Plastic of all kinds—virgin, reground, lumps, sheet and reject parts. Highest prices paid for Styrene, Polyethylene, Acetate, Nylon, Vinyl, etc. We can also supply virgin & reground materials at tremendous savings. Address your inquiries to: Gold-Mark Plastics Compounds, Inc., 4-05 26th Ave., Long Island City 2, N. Y. RAvenswood 1-0880.

Molds for sale

FOR SALE OR EXCHANGE: Complete set of molds to make melamine dinnerware. Beautifully designed, in excellent condition. Will put you in the dinnerware business in one swoop, or supplement your present line. Will consider exchange for a line of injection molds for houseware, or what have you? Write in confidence. Reply Box 5103, Modern Plastics.

FOR SALE: Houseware molds, comb molds, also some novelty and specialty items. All in excellent condition. No reasonable offer refused. Send for list. Reply Box 5109, Modern Plastics.

Molds wanted

WANTED: Mold for Bowling Pins, 48 oz. to 52 oz. Write: Rupert Terry, 11334 Hunt, Romulus, Michigan.

WANTED: Bucket die round or square approximately 10 quart capacity. List all dimensions. Reply Box 5104, Modern Plastics.

Help wanted

PRODUCTION MANAGER: Film Extrusion. Exceptional opportunity in South America to establish initial production. Must have minimum of three years in a supervisory capacity —thorough practical knowledge of machine and die design, etc. Maintenance and repairs of all extrusion and auxiliary equipment. Forward complete resume. Reply Box 5115, Modern Plastics.

HELP WANTED: We need an experienced extrusion administrator, able to estimate, schedule, purchase materials, customer relations, sales. Interesting well paid opportunity for right man. Fast growing modern plant in metropolitan New Jersey area. Reply Box 5120, Modern Plastics.

PRODUCTION MANAGER: Calendered vinyl film. Eastern plant calendering lightweight vinyl plastic film seeks top-flight production manager to supervise all operations. Must be thoroughly familiar with all phases of vinyl film production. Top salary. Write full particulars, in confidence. Reply Box 5107, Modern Plastics.

WANTED: Production Supervisor wanted by rapidly growing plant presently engaged in polyethylene extrusion coating of paper, cloth, cellophane, etc. Excellent opportunity for man qualified to handle production, scheduling, and personnel. Reply Box 5119, Modern Plastics.

CHEMICAL ENGINEER: Experienced in vinyl organosol coating, laminating and knit back stretch leather. Position available for product development and research with coating plant with strong financial resources available for expansion. State all facts, experience, references, age and salary expected. Crawford Manufacturing Co., Richmond, Virginia.

PLASTIC ENGINEER: To take charge of large tooling program of AAA1 manufacturer of plastic and other toys. Must be capable of supervising design and construction of injection and vacuum molds, deal with contractors, troubleshoot initial production problems, act as liaison between design-tooling and production. Also design jigs, fixtures and special machinery. Excellent opportunity with rapid advancement for right man who can handle this responsible position. Location N. Y. C. Write full details as to background and past experience. Reply Box 5121, Modern Plastics.

SALESMAN - CHEMIST DESIRED: This man must be experienced in the development, manufacture and selling of Melamine, Urea and Polyester Resins. He will head up a new department of a well established chemical coating producer in the middle west and affords an excellent opportunity for the right man. Submit complete resume, which will be held in strict confidence. Reply Box 5113, Modern Plastics.

WANTED: Manufacturer's Agents. Plastics extrusion firm with excellent capacity and ability in extrusions of all types of resins and all shapes and forms, including tubing, setting up national sales representative group to cover all custom extrusion markets with particular emphasis on original equipment contracts. All territories open. Reply Box 5105, Modern Plastics.

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PLASTICS MACHINERY DEVELOPMENT ENGINEER: A responsible position is open for an experienced engineer with a talent for developing new machinery and applying existing machinery to plastics compounding problems. The applicant must have spent considerable time in the technical service department of a major resin manufacturer or in the engineering department of a plastics extruder manufacturer. Please include educational background, a detailed description of previous experience, as well as salary requirements in your reply. Reply Box 5106, Modern Plastics.

REPRESENTATIVE WANTED: Swiss firm under development, producing high-class goods in field of synthetic materials is looking for Swiss or European representation for fiberglass or resin and Teflon. Yearly glass-input about 1000 tons. Box-number OFA 4408 CH. Orell Fussli-Annonces, Zurich, Switzerland.

MANUFACTURERS' REPRESENTATIVE: Well-known manufacturer of injection molding machines seeking top flight sales organization for representation on West Coast. We are a well established United States firm, long engaged in the manufacture of heavy equipment. Reply Box 5100, Modern Plastics.

PERSONNEL: Executive—Technical—Sale—Production. Employers and Applicants—whatever your requirements, choose the Leader in Personnel Placement. Cadillac Associates, Inc., Clem Easly—Consultant to Plastics Industry, 220 South State, Chicago 4, Ill.—Wabash 2-4800. Call, write or wire—in confidence.

HELP WANTED: Combination Production and Salesman of plastisol, solvent, emulsion coated, printed, laminated films, paper, fabrics. Have 72" unit with desire to expand. Be top man in new department. Let's talk. Send resume. Continental Chemical Co., Cayce, S.C.

OPPORTUNITIES for Plastics, Mechanical or Chemical Engineers: Permanent, responsible positions are available in the field of plastics applications. Positions include the development of procedures, equipment and fabrication methods to manufacture products from polyolefin materials. Excellent working conditions, modern facilities, retirement and insurance programs, company contributed savings plan. Good location in modern, medium-sized, Southwestern community with excellent family recreation, religious and educational facilities. Reply by letter giving age, experience and other qualifications. All applications carefully considered and kept strictly confidential. Write: Personnel Procurement, Research and Development Department, Phillips Petroleum Company, Bartlesville, Oklahoma.

Situations wanted

TECHNICAL SALES: Challenging opportunity wanted. Two years successful experience in fiber glass product development. B.S. degree in Physics. Military service completed. Age 24. Complete resume on request. Reply Box 5102, Modern Plastics.

EXTRUSION — PLASTIC ENGINEER: Compounding—all thermoplastics, extrusion of shapes, contours in acetate, vinyls, styrenes, polyethylene. Plant management and supervision of extruders, Banbury mills and other plastic equipment. Formulating, engineering, designing. College. Married. Seeks opportunity with adequate compensation for 15 years of experience and skill. Reply Box 5116, Modern Plastics.

Miscellaneous

WANTED: James Ferguson & Sons Ltd., Lea Park Works, Merton Abbey, London, S.W. 19, manufacturers of phenolic and urea resins and moulding materials etc., would be interested in acquiring improved plant, or license for same, for the production of Polyester Translucent Sheeting, which they are already producing on a small scale. Reply to the Technical Director.

OPPORTUNITY: Leading Hong Kong pleasurecraft Builders wish to contact well established American Plastic boat manufacturer interested in jointly making plant in Hong Kong. Can offer world's cheapest skilled labour, factory and local management. Needs tradename, designs, technology and U.S.-sales organization. Freight rates Hong Kong-U.S.A. very favourable. Write: the East Asiatic Co. Ltd., P.O. Box 835, Hong Kong.

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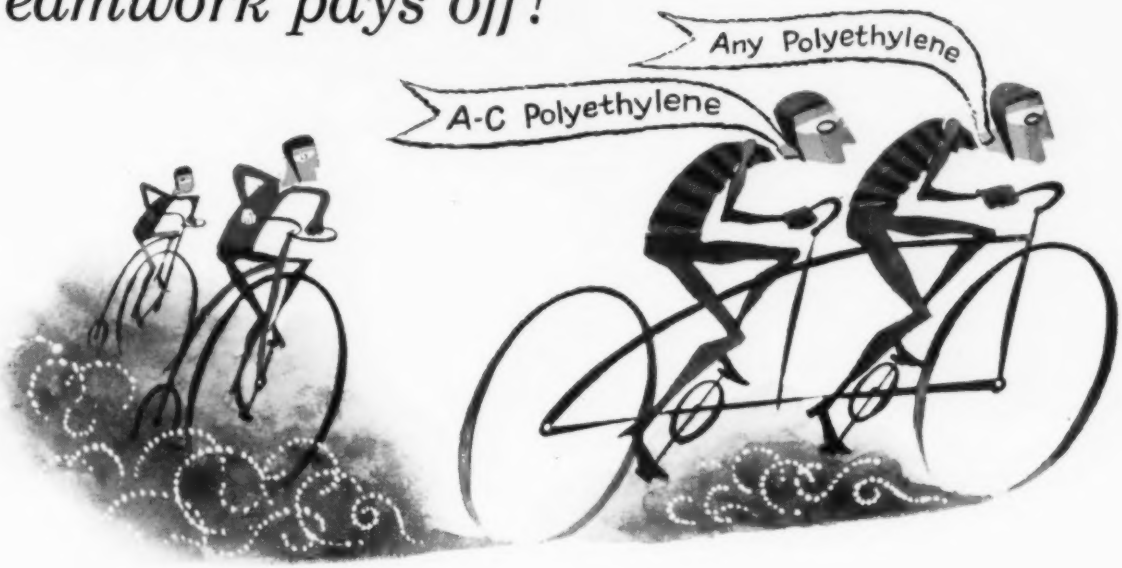

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See the difference for yourself! Blend A-C Polyethylene with your regular polyethylene resins, particularly the lower melt indices. Here's what happens!

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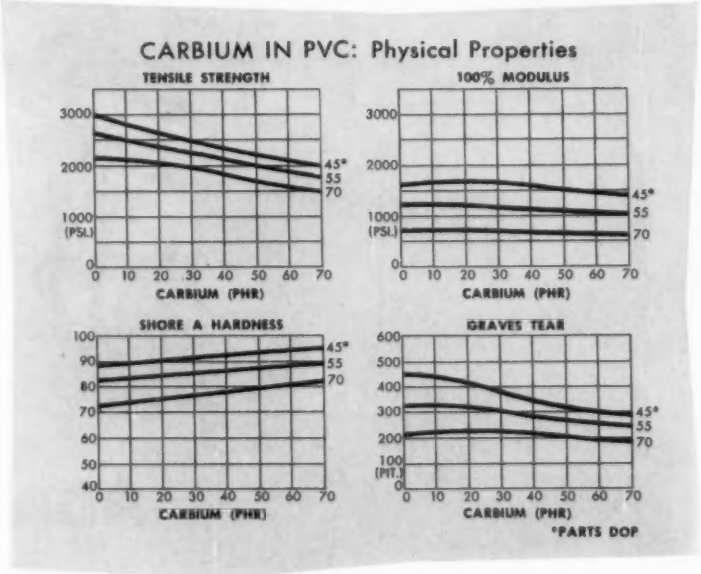

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As a dependable source of phthalic anhydride, maleic anhydride and fumaric acid, we're well experienced—and *ready*—to assist you with your application problems.

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All parts molded by Cutler-Hammer, Inc. of Milwaukee, Wisc. from new G-E 12930 phenolic compound.

FOR THE TOUGH JOBS

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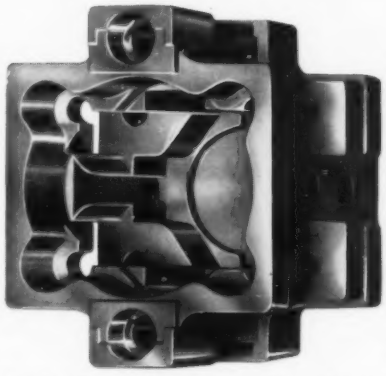
Cutler-Hammer and other leading molders are demonstrating that a new general-purpose compound, G-E 12930, is tops for molding a wide range of complex parts throughout the shop.

A key reason: G-E 12930 has unusually long flow duration, best illustrated by its preheat characteristics. It has been found that it can be transfer- or compression-molded even after 45 seconds have elapsed between a normally hot preheat and molding. It will also tolerate a smoking hot preheat, without exhibiting precure. In addition, preheat and cure times are shortened considerably.



Cutler-Hammer uses G-E 12930 in both compression and transfer molding — calls it an extremely versatile high-speed compound capable of handling most of the jobs in the shop and giving considerable latitude on each of these jobs.

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